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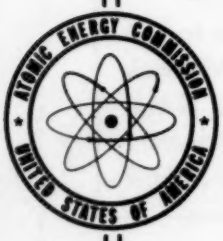

Technical Information Service, Oak Ridge, Tennessee

For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. - Price $1.75

*MDDC - 1507 The Dry Box. Los Alamos. 21 p. (LADC-457)

This includes the declassification of the Los Alamos dry box and consists of twenty-one scale drawings.

MDDC - 1508 Investigations on the Absorption Spectra Induced in Single Crystals of Magnesium Oxide by Exposure to Various Types of Radiation, by C. A. Boyd, D. Rich, and E. Avery, 27 p., September 16, 1947. (ANL-4053)

For publication in the Journal of Chemical Physics.

The work described is mainly directed towards the detection and analysis of the absorption band in MgO crystals which is induced in the near ultraviolet region by exposure to pile radiation. To accomplish the analysis, advantage was taken of the fact that the various components underwent thermal decay at different rates thus making a separation possible. In this fashion, the absorption spectra of a sample which was exposed for 8 hours in heavy water pile was shown to be composed of 4 components, the first of which was found to have extreme stability even at 900°C. The second and fourth components were relatively unstable and disappeared after 15 minutes heating at 600°C. The third component was more stable and required several hundred minutes of heating at 600°C in order to decay out. In addition, two other bands of extreme thermal instability were found upon exposure to 1 Mev electrons from the Van de Graaff generator. One band appears in the near ultraviolet and is of a very complex nature, and the other is a broad single band with a maximum at approximately 525 mμ.

By the displacement method, all 4 components have been produced and examination of the thermal decay data show that the second and fourth components disappear at approximately the same rates.

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MDDC - 1508

Investigations on the Absorption Spectra Induced in Single Crystals of Magnesium Oxide by Exposure to Various Types of Radiation, by C. A. Boyd, D. Rich, and E. Avery, 27 p., September 16, 1947, (ANL-4053) (Cont'd from page 1)

These facts would seem to indicate that the disturbance giving rise to the second component is due to the removal of an electron from an ion since it is only produced by displacement methods and not by additive methods. Also, the simultaneous disappearance of the second and fourth components upon thermal decay would lead one to suspect that this is due to the transfer of electrons back to the ion from some type of color center which is responsible for the fourth component. This mechanism would account for the fact that the thermal decay of the second component does not follow the first order process equation.

It is felt that the extremely stable first component may very well be due to the trapping of one electron in a divalent negative ion vacancy because of the fact that it is such a stable band.

At present no information is available which can be used to speculate on the cause of the third component.

Sixteen graphs are included.

MDDC - 1509

The Synthesis of Phenanthrene-9-C^{14}, by C. J. Collins and W. G. Brown, 10 p.

For publication in the Journal of the American Chemical Society.

Fluorene (I) has been converted to 9-fluorenecarboxylic acid-10-C^{14} (III) by carbonation of 9-fluorenesodium (II) with carbon dioxide-C^{14}. Lithium aluminum hydride reduction of the methyl ester (IV) yielded 9-fluorene-methanol-10-C^{14} (V). Dehydration of V with phosphorous pentoxide was accompanied by a Wagner rearrangement to form the desired phenanthrene-9-C^{14} (VI) in overall yields of 50-55%.

*MDDC-1510 Note on the Stability of Pu(IV) in Alkaline Solution, by R. E. Connick, W. H. McVey, and G. E. Sheline, 2 p., August 10, 1946.

To be included in the NNES (MPTS), and to be used in lectures and seminars.

The stability of Pu^{+4} with respect to air oxidation was investigated in alkaline solution.

The experiments described gave little if any indication of air oxidation of Pu(IV) in alkaline solution. Recent potential and equilibrium measurements have made possible the estimation of the Pu(IV)-Pu(VI) potential in alkaline solution. These calculations indicate that oxygen at 1/5 atmosphere does have sufficient potential to oxidize Pu(IV) to Pu(VI) nearly completely in the above solutions, although the driving force is not great. In conformity with many other oxygen oxidations with small driving potential, this reaction is apparently quite slow.

*MDDC-1511 Note on the Stability of Pu(VI) in Alkaline Solution, by R. E. Connick, W. H. McVey, and G. E. Sheline, 5 p., August 10, 1946.

To be included in the NNES(MPTS), and to be used in lectures and seminars.

Experiments were performed to check the work of previous investigators who presented evidence of instability of Pu(VI) with respect to reduction to a lower oxidation state in alkaline solution, the reducing agent presumably being water.

Their results could not be confirmed, and it was found that Pu(VI) is quite stable in alkaline solution (.5M NH_4OH or .5M NaOH) at room temperature with respect to reduction by water.

Recent estimations of the potential of the Pu(IV)-Pu(VI) couple in alkaline solution would make it appear that the Pu(VI) is not thermodynamically capable of liberating oxygen from the 0.5M NaOH solution. In the case of the 0.5M NH_4OH solution, which also contained NH_4^+, the potentials are probably close enough that oxygen could have been liberated. However, in analogy to other similar reactions the rate would be expected to be small.

MDDC - 1512

The Quantitative Spectrographic Analysis of the Rare Earth Elements, by V. A. Fassel and H. A. Wilhelm. 31 p.

For publication in the Journal of the Optical Society of America.

Spectrographic methods applicable to the determination of small amounts of rare earth impurities in other rare earths are described. The specific examples discussed are the determination of samarium in neodymium and of europium in samarium. The procedures involve the high current d-c arc excitation of rare earth oxide-graphite mixtures. Selected lines of the major rare earth constituent are used as internal standards. The experimental error of these methods is about 4%. Studies on the variation of the analytical intensity ratio during excitation and the effect of large changes in arc current, per cent graphite, and weight of sample charge on the intensity ratio values are included.

MDDC - 1513

The Preparation of Technetium Metal, by S. Fried, 3 p., October 1, 1947. (ANL-HDY-325)

For publication as a Letter to the Editor in the Journal of the American Chemical Society.

Technetium metal was prepared from two samples of ammonium "per" salt, probably NH_4TcO_4.

A 119 microgram sample was dissolved in 100 microliters of 4 N HCl in a microcone which was placed in a water bath heated to 80°C. Hydrogen sulfide was passed over the resulting pink solution for a period of one hour and a brownish, flaky precipitate was observed to form slowly. The precipitate was centrifuged, washed, and dried in vacuo at room temperature. A sample of this sulfide which was submitted for x-ray diffraction analysis gave a pattern which has not yet been interpreted.

The sulfide was transferred to a quartz capillary which was attached to a vacuum line in such a manner that hydrogen could be admitted onto the heated sulfide and then removed by pumping.

When the compound was treated with hydrogen at 1000°C for three two-minute intervals with intervening evacuation a black cindery mass resulted and a yellow material sublimed out, presumably sulfur. The black material was transferred to an x-ray capillary and submitted for x-ray analysis. It was

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MDDC - 1513 The Preparation of Technetium Metal, by S. Fried, 3 p., October 1, 1947. (ANL-HDY-325) (Cont'd from page 4)

reported to be technetium metal, isomorphous with rhenium, osmium, and ruthenium.

Technetium metal does not dissolve in H_2O_2-NH_4OH mixture or in H_2O_2 alone as does Re metal, nor does it dissolve in HCl.

*MDDC - 1514 Calculation of Internal Conversion Coefficients, by G. Goertzel and M. E. Rose, 15 p., November 13, 1947. (MonP-426)

For publication in the Physical Review.

The analytical part of the calculation of internal conversion coefficients, using relativistic wave functions, has been carried out for electric and magnetic multipoles of arbitrary order and for the K, L_I, L_{II}, and L_{III} shells.

*MDDC - 1515 Techniques for the Preparation of Thin Films of Radioactive Material, by D. L. Hufford and B. F. Scott, 55 p., November 2, 1945 (CN-3328)

To be included in the NNES(MPTS).

Many fundamental measurements on radioactive material require a thin, uniform, smoothly spread source of activity. This requirement has instigated research involving varied principles and techniques whereby smooth films of radioactive deposits may be prepared. This report is concerned chiefly with the preparation of films of uranium and plutonium. However, the principles and techniques described can be applied to other radioactive elements in many instances.

Five general methods, the normal evaporation technique, the tetraethylene glycol spreading technique, the slurry spreading technique, the electrodeposition technique, and the sublimation technique, have been employed sucessfully and each of these methods is described in a separate section of this report.

Eleven pages of diagrams are included.

MDDC - 1516 The Reaction $He^3(n,p)H^3$ and the neutrino mass, by D. J. Hughes and C. Eggler, 4 p., September 29, 1947 (ANL-HDY-290)

For publication as a Letter to the Editor of the Physical Review, and for oral presentation before a meeting of the Physical Society.

The mass of the neutrino can be measured by a careful determination of the Q value for a reaction involving nuclei of accurately known masses, including a β-emitter of known end point. Since the end point energy is measured by extrapolation, such measurements do not give the neutrino mass to a greater accuracy than is given by the shapes of the spectra themselves. In order to minimize the end point difficulty, Q values for the reactions $N^{14}(n,p)C^{14}$ and $He^3(n,p)H^3$ (low energy β) were measured from the proton range in a cloud chamber.

The following Q values and proton energies were obtained:

He^3: Q = 740 Kev E_p = (555 $\pm$ 5 Kev) - $3/4\,\mu c^2$

N^{14}: Q = 597 Kev E_p = (558 $\pm$ 9 Kev) - $14/15\,\mu c^2$

The neutrino mass values are:

He^3: μc^2 4 $\pm$ 25 Kev; N^{14}: μc^2 = 1 $\pm$ 25 Kev.

The experiment shows that the mass of the neutrino for H^3 and C^{14} is the same within about $0.01\,\mu c^2$. This finding seems to rule out a suggestion made by Oppenheimer that different neutrino masses exist. The present results also indicate that the neutrino mass in the H^3 disintegration is less than the value calculated by Konopinski as necessary to explain the H^3 lifetime.

MDDC - 1517 An Ionization Chamber for Alpha-Ray Measurements, by R. Livingston, 8 p., June 23, 1945. (CP-3065)

The study of polonium-alpha induced chemical reactions has necessitated a device for counting alphas from several millicuries of polonium mounted on foils. The Segre type of ionization current chamber has the disadvantage of a non-linear calibration curve with a somewhat involved calibration procedure.

A modified Segrè type ionization chamber allows the assay of millicurie amounts of polonium supported on foils. An argon atmosphere facilitates attainment of saturation. Calibration of the chamber gave values of 26.1 ev for the energy required for formation of an ion pair in argon, 1.35 for the relative ionizing power of argon, and 35.2 ev for the energy to form an ion pair in air, all of which agree well with published values.

MDDC - 1518 Use of Code Words, by Los Alamos Declassification Group, 1 p. (LADC-261)
(The whole document is reproduced here.)
Several terms have come into common usage on the Manhattan Project, and because of their concise convenience, they may remain useful.

When referring to heavy elements, in particular those with Z = 90 or above, the last digit of the Z number and the last digit of the Mass number have been used as a two digit symbol. For example, the symbol for $_{92}U^{235}$ becomes "25"; and $_{94}Pu^{239}$ is represented by "49". This notation is useful only if the first digit of the Z number is the same in all cases.

The "barn", in referring to cross sections for nuclear or atomic processes, has been used in place of 10^{-24} cm^2. Thus, a cross section of "5 x 10^{-24} cm^2" would be written as "5 barns", and is much more convenient in conversation.

The "water boiler" is the homogenous, enriched uranium chain reactor in use at Los Alamos.

Tuballoy refers to uranium with its naturally occurring isotopic constitution.

MDDC - 1519 Waterproofing and Shockmounting Portable Meters, by E. W. Molloy, 4 p., February 28, 1944 (CP-1454 [A-2042])

This investigation and development was carried out in the belief that it may be necessary to operate radiation detection equipment under severe conditions of humidity and that such equipment may be subjected to strong mechanical shock.

The following is a list of points investigated:

1. Waterproofing of controls.
2. Guarding against mechanical damage to controls.
3. Shockproofing meter movements and circuit parts.
4. Protecting high resistance units against moisture.

Two sketches and two photographs of methods of waterproofing controls are given.

MDDC - 1520 The Crystal Structure of Element 43, Technicium, by R. C. L. Mooney, 4 p., September 19, 1947. (ANL-4033)

For oral presentation before a meeting of the Physical Society, and for publication in the Physical Review.

The chemical properties of the element of nuclear charge 43, now named technicium, were studied by C. Perrier and E. Segre in 1937 from a sample made by cyclotron bombardment of molybdenum. Many activities exist, including a long-lived isotope probably of mass 99, which is also formed by fission. A sample containing this long-lived isotope was prepared by the Clinton Laboratory, for an attempt at an X-ray crystal analysis of the compounds of this element. Dr. Sherman Fried has prepared several of these, and a report on their crystal structure is to be expected later.

The purpose of the present note is to give the crystal structure of the pure element itself, which was prepared in metallic form in microgram amounts.

Like rhenium, osmium, ruthenium, and a number of other elements, technicium has been found to crystallize in the hexagonal close-packed arrangement.

The cell, which contains two atoms, has the following dimensions:

$a_1 = 2.735 \pm 0.001$ Å $\qquad d_3 = 4.391 \pm 0.001$ Å

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MDDC - 1520

The Crystal Structure of Element 43, Technicium, by R. C. L. Mooney, 4 p., September 19, 1947. (ANL-4033) (Cont'd from page 8)

Each atom has twelve nearest neighbors, six at 2.704 $\mathring{A}$, and six at 2.735 $\mathring{A}$.

The density, assuming the atomic weight to be 99, is calculated to be 11.487gm/cm^3.

MDDC - 1521

On Gaseous Self-Diffusion in Long Capillary Tubes, by W. G. Pollard and R. D. Present 32 p.

For publication in the Physical Review.

A calculation is made of the rate of diffusion of "tagged" molecules in a pure gas at uniform pressure in a long capillary tube of half length L and radius a. At pressures for which the mean free path $\lambda \gg a$, the result in the limit $L \to \infty$ reduces to that already obtained by M. Knudsen, the diffusion coefficient D being given by $2a\bar{v}/3$ where $\bar{v}$ is the mean molecular speed. For a capillary of finite length the diffusion coefficient is, to first order in a/L, smaller than this by a factor 1 - 3a/4L. In the opposite limit of high pressures for which $\lambda \ll a$, the result reduces to the elementary kinetic theory expression for the self diffusion coefficient, $D=\lambda\bar{v}/3$. One of the most significant features of the result is that in a long tube the diffusion coefficient drops very rapidly with increasing pressure from its initial value for $\lambda \gg L$. Thus the initial slope of D as a function of pressure is given by $dD/d(a/\lambda) \cong -\frac{1}{2}\bar{v}aln L/a$. It is shown that these results account for the anomalous low-pressure minima observed by several investigators who have measured the specific flow $G/\Delta p$ through long capillary tubes as a function of mean pressure $\bar{p}$. The failure to observe such minima with porous media, for which effectively $L \approx a$ in each pore, is also explained by these results. The formulae obtained here represent a rigorous solution to the long capillary diffusion problem valid at all pressures and subject only to the limitations of the mean free path type of treatment.

MDDC - 1522 Triphosphatase and Other Phosphatases on the Surface of Living Yeast Cells, by A. Rothstein and R. Meier, 13 p. (II-188-7465)

For oral presentation before the Federation Meeting and for publication in the Federation Proceedings. (Federation of American Societies for Experimental Biology)

Various phosphate compounds such as adenyltriphosphate (ATP), adenyldiphosphate (ADP), α glycerophosphate, inorganic triphosphate, inorganic pyrophosphate added to a suspension of washed, starved living Bakers' yeast (Standard Brands) are hydrolyzed with the production of inorganic ortho-phosphate. An extensive study of muscle and yeast ATP breakdown indicates that during hydrolysis, the products (adenylic acid and inorganic phosphate in the ratio of 1:2) and unused substrate can be recovered quantitatively from the medium. In addition, if ATP with radioactive phosphate (P_{32}) is hydrolyzed by the cells, all of the P_{32} is recovered in the medium with none in the cells. These experiments indicate that the enzyme is at or in the cell surface. However, the enzyme is firmly bound, because the medium separated from the cells shows no activity.

A study of the pH-activity curves and of competition or non-competition of various substrates with each other, indicates that ATP, ADP and inorganic triphosphate are hydrolyzed by a single enzyme with a pH optimum of 3.5 and almost zero activity at 7.0 and higher. The αglycerophosphate and inorganic pyrophosphate are hydrolyzed at a lower rate by other enzymes which are active at pH 6.0 and below but with no well defined optimum.

The limiting substrate concentration for the ATP hydrolysis is about 0.7×10^{-3} M. With optimum ATP concentrations the rate of hydrolysis is directly proportional to yeast concentration (enzyme concentration). The time course of hydrolysis, however, follows an asymptotic curve rather than a linear function due not to destruction of enzyme but to inhibition by the products of the reaction, inorganic phosphate and adenylic acid. A synergistic effect between these two substances seems to be involved. The inhibition due to the phosphate is greatly increased by the adenylic acid, which by itself has no effect.

Twelve graphs are included.

MDDC - 1523 High Resistance Bridge(Range 10^5 to 10^{12} Ohms). by R. J. Smith. 6 p., November 23, 1944. (CP-2434)

The instrument is designed to afford a quick and accurate secondary calibration for high value resistors or as use as a 0-10 ratio comparison method for checking against a standard of one's own selection. Measurements are made with less than one volt on the unknown and 0.1 volt appears across the standard resistor in all measurements.

Readings may be made within less than 1% of the standard resistors and duplication of readings may be made within a small fraction of 1%. This is made possible by the two-thirds division per mv. sensitivity of the null indicator. The accuracy of the instrument then depends primarily upon the careful calibration of the standards. The secondary limitation is that high resistances, those above 10^{10} ohms, make the time constant of the null circuit large and make it sensitive to changes in capacity. This sensitivity causes a deflection as the "Null Set" switch is moved and makes the balancing process somewhat slower than when measuring lower resistances.

Operating instructions are given as well as a description of construction, calibration, and maintenance. A circuit diagram and photograph of the instrument are also included.

MDDC - 1524 A Study of Variations Accompanying Low Current Ionization Chamber Measurements, by R. K. Swank and H. Palevsky, 22 p., June 15, 1945. (CP-2971)

It was observed that when an ionization chamber was attached to a vibrating reed electrometer, a small current, which had variations of much greater magnitude than could be attributed to the measuring instrument, was indicated. Variations were also noticed with a Beckman D. C. Amplifier. Measurements made with a Lindemann Electrometer showed about the same magnitude of background currents, but the variations visually observed were about five times smaller than those recorded by the Vibrating Reed Electrometer.

A test chamber was constructed, and tests performed to determine the nature of the background current and variations. The background variations are due to the nature of the source producing the background current. A rough calculation seems to indicate that the background observed with the chamber shielded by three inches of lead may be produced by mesotrons.

The smaller variations shown by the Lindemann Electrometer, as compared to the vibrating reed instrument, may be accounted for by the difference in the period of the two instruments.

Contribution of α contamination and the effects of differences in pressure in the chamber were also investigated.

MDDC - 1525 Artificial Radioactive Isotopes of Polonium, Bismuth and Lead, Chapter III Light Isotopes Produced by High Energy Particles, by D. H. Templeton, 14 p. (BC-52)

For use as a doctoral thesis.

Bombardment of lead and bismuth with 200 Mev deuterons and 400 Mev helium ions produced nearly a score of new isotopes of elements 79 to 85 with half-lives between 10 minutes and 10 days. Their formation can be explained in most cases by reactions of the type (d,xn) or (α,xn) followed by orbital electron capture decay. As yet little progress has been made in characterizing and identifying individual isotopes in these complex mixtures. The periods observed in lead and bismuth after bombardment are tabulated.

To fit the observed activities in a reasonable manner into an isotope chart, one must use masses at least as light as 195. This corresponds to a (d, 13n) reaction on Pb^{206}. Probably some of these isotopes are even lighter than this.

The fact that considerable numbers of short alpha periods are observed in both bismuth and polonium suggests that the very light isotopes of the lighter elements may also be alpha active. The failure to detect positrons in these mixtures shows that positron emission is at best a rare mode of decay for isotopes of these elemerts. No case of positron decay has been verified for any element heavier than the rare earths.

*MDDC - 1526 The Conversion of UF_4 to U_3O_8, by A. D. Tevebaugh, R. D. Tevebaugh, W. D. Cline, and J. C. Warf, 6 p.

To be included in the NNES(MPTS).

Methods of conversion of UF_4 to U_3O_8 by fusion with ammonium oxalate dihydrate and other salts are described. A pyrohydrolytic method is described whereby a mixture of steam and air at 800°C is used to convert UF_4 to U_3O_8.

MDDC - 1527

Laboratory Handling of Radioactive Material; Protection of Personnel and Equipment, by P. C. Tompkins, 24 p.

For publication by the Office of Naval Research.

Both personnel and equipment must be protected from an undesirably high intensity of external radiation and from adverse results due to radioactive contamination. Radiation protection is provided by a combination of distance and massive shielding between the source and the operator or instrument. Contamination control is provided by the development of "aseptic" technique. To accomplish the latter, steps must be taken to keep active material confined to the interior of the equipment and provision must be made for the detection, removal and subsequent disposal of any active material that gets outside the equipment.

Techniques which have been developed to accomplish the above in such operations as sampling, preparation of experimental solutions, evaporation, filtration, and injection of radioactive materials are described and illustrated.

Ten photographs are inclosed.

MDDC - 1528 The Preparation of Molybdenum Hexafluoride, by H. A. Bernhardt, H. W. Bishop and J. P. Brusie, 3 p.

For publication in the Journal of the American Chemical Society and to be included in the NNES (MPTS). Using method described by Ruff (Benchte, 40, 2926-2935, 1907) but at 315°C MoF_6 was prepared.

The product obtained was a white crystalline solid which turned to a light yellow liquid at room temperature. Molybdenum hexafluoride decomposes at once if it is allowed to come in contact with moist air. It melts at about 17°C. and boils at around 35°C. The yield of product obtained was 78 per cent of the theoretical.

A diagram of the apparatus used is given.

* MDDC - 1529 The Ionization and Dissociation of Uranium Tetrachloride and Uranium Hexafluoride by Electron Impact, by E. H. S. Burhop, H. S. W. Massey, and C. Watt, 34 p. (BP-37)

To be included in the NNES (MPTS).

Measurements have been made of the relative intensities of a number of ion beams produced by electron impact for different electron energies, current densities and pressures. Also the appearance potentials for the various ions have been measured. The Processes by which the various ions are formed are discussed on the basis of these measurements and some of the available chemical constants. An attempt to measure the ionization potential of uranium metal is discussed.

A sketch showing a sectional view of the arc chamber and analyzer and eight graphs are included.

*MDDC - 1530 Angular Dependence of Coincidences between Fission Neutrons, by S. DeBenedetti, J. E. Francis, Jr., W. M. Preston, and T. W. Bonner, 1 p.

For oral presentation before a meeting of the American Physical Society and for publication in the Bulletin of the American Physical Society.

This article is an abstract, and is reproduced here in its entirety.

Coincidences between fission neutrons were measured at angular separations of 30^{o}, 60^{o}, 90^{o}, 135^{o}, and 180^{o}. The source was a sample of U^{235} irradiated in a beam from the Clinton Pile. The neutrons were detected with two proportional counters containing hydrogeneous material in the form of 20 polythene films perpendicular to the wires. The counters were located in a plane perpendicular to the beam and were connected to a coincidence circuit of $3\ 10^{-7}$ sec resolving time. The spurious coincidences, measured with a PoBe source of the same strength as the fission sample, consisted of random coincidences (considerably more numerous than the desired effect) and of coincidences arising when the same neutron produced a recoil in both counters (important only at 30^{o}, where they about equaled in number the true coincidences). After substraction of the spurious coincidences the final results are affected by a statistical error of about 10%. The number of coincidences is constant from 30^{o} to 90^{o} and increases by a factor of 2 from 90^{o} to 180^{o}. Using the hypothesis of neutron emission from fragments in motion, this results shows that when more than one neutron per fission is emitted, both fragments contribute to neutron emission.

*MDDC - 1531 Conversion of Air Proportional Counter Alpha Detection Instruments ("Poppy") to Detect C^{14} Contamination and Soft Beta Radiation, by R. H. Firminhac, 7 p., November 7, 1947. (MonH-448)

Soft beta emitters such as C^{14}, S^{35} and others are usually not detected by instruments ordinarily used to find beta contamination for health protection and other purposes for at least two reasons: (A) The range of such beta particles in the air is only of the order of one foot, so that smaller areas of high contamination might easily be overlooked when surveying a room, and (B) the walls of even the "thin-window" instruments usually stop a large fraction, if not all, of the soft beta particles.

Methods are suggested for conversion of air proportional counters, usually used for survey of alpha contamination in direct surface contact, for detection of the soft beta particles described above.

MDDC - 1532 Excitation Function of the Reaction $C^{12}(n, 2n)C^{11}$ at High Energies, by W. Heckrotte and P. Wolff, 3 p., November 3, 1947. (UCRL-6)

For Publication as a Letter to the Editor of the Physical Review.

The excitation curve for the reaction $C^{12}(n, 2n)C^{11}$ is calculated for energies up to 100 Mev. The reaction can go in three ways: (a) $n + 6^{12} \rightarrow C^{*13}$, $C^{*13} \rightarrow C^{11} + 2n$; (b) $n + C^{12} \rightarrow C^{12} + n$, $C^{*12} \rightarrow C^{11} + n$; (c) $n + C^{12} \rightarrow C^{11} + 2n$ (knock out).

The results of the calculations for 50% charge exchange are shown in graphic form. The calculated cross section for the reaction at 90 Mev is .011 barns for 100% charge exchange and .013 barns for 50% charge exchange. The experimental value is 0.025 + .004 barns.

The ratio of the cross section of the reaction $C^{12}(p, pn)C^{11}$ to the cross section of the above reaction at 90 Mev is 5.8 for 100% charge exchange and 3.8 for 50% charge exchange. The experimental ratio is 2.7 at 90 Mev. This difference in cross sections between the two reactions is established by two factors. First, there is the part played by charge exchange in the $C^{12}(p, pn)C^{11}$ reaction which leads to excited N^{12} with the subsequent boiling off of a proton, while a similar exchange process cannot take place for the $C^{12}(n, 2n)C^{11}$ reaction. Second, there is the difference between the contributions of the knock out process as a result of the difference in the n - p and the n - n cross sections, which favors the $P + C^{12}$ knock out reaction.

The results seem to give a good qualitative picture of the contributing factors affecting the total reactions.

*MDDC - 1533 The Clinton Pile Oscillator, by J. I. Hoover, et al., 1 p.

To be presented at the January meeting of the American Physical Society.

This paper is an abstract and is given here in its entirety.

The pile oscillator is an instrument for measuring thermal neutron absorption cross-sections. In the form used here, it consists of a small beryllium boat which is made to oscillate in the region of the graphite reflector of a pile, with an amplitude of about 15" and a frequency of about 1 cycle per second. At the middle of the stroke the boat passes along the axis of a cylindrical boron-coated ion chamber. The depression of the neutron flux in the vicinity of the absorber produces an alternating current in the ion chamber which is then amplified, rectified and integrated. The absorption cross-section of an unknown sample is determined by comparing the charge accumulated in the integrating circuit with that obtained by a standard gold absorber. The instrument will detect a total absorption cross-section of about 10^{-3} cm^2. One of the major difficulties in making this instrument reliable for absorption measurements has been that of eliminating the effects of scattering by the sample. In the present instrument no correction for scattering is necessary when the absorption cross-section is greater than 1% of the scattering cross-section.

MDDC - 1534 Studies on the Metabolism of Radioactive Nicotinic Acid, by L. J. Roth, E. Leifer, and W. Langham, 9 p. (LADC-467)

For publication in Science.

It is shown that 51 per cent of the nicotinic acid inject intraperitoneally into mice is metabolized and excreted in 100 hours. The distribution of C^{14} activity in the urine, CO_2, and feces is 45.1, 4.2 and 1.5 per cent of the injected dose respectively. The activity in the red blood cells decreased only slightly from the fourth through the eighth day.

A sketch of the apparatus used is shown.

MDDC - 1535 **Techniques for Irradiating Microorganisms with Artificially Radioactive Materials, Part I - Radioactive Material in Suspension, by G. E. Stapleton, E. Loftus, and I. Armstrong, 13 p.**

For oral presentation before a meeting of the American Association for the Advancement of Science to be held in Chicago, and for publication in the American Journal of Botany.

Technique and equipment for the safe handling of radioactive-tracers in liquid and agar suspensions are discussed.

Methods include the preparation, incubation, and isolation of agar-plate cultures containing radio-phosphorus in high concentration, up to several millicuries of activity.

Further description includes the use of liquid suspensions containing radio-phosphorus. Pipetting, storing, washing, plating and isolation of micro-organisms are discussed and demonstrated.

Special precautions for protecting the experimenter and others in the laboratory are emphasized.

Five photographs showing equipment and technique are included.

MDDC - 1536 **Inelastic Scattering of Fe, Pb and Bi, by L. Szilard, S. Bernstein, B. Feld, and J. Ashkin, 12 p., August 27, 1947. (MonP-375)**

For publication in a professional physics journal.

Measurements of inelastic scattering effects of Ra - α - Be and Ra - α - B neutrons in Fe, Pb and Bi have been made. A U^{238} fission threshold detector was used. The method consisted in measuring the fission counting rate in the detector with and without the spherical scatterer surrounding the source. From the decrease in the counting rate caused by the presence of the scatterer, values of the cross-section for inelastic scattering to below the U^{238} fission threshold were calculated for several assumed values of the elastic scattering cross-section.

*MDDC - 1537 Crystal Structure Studies of Sulfides of Plutonium and Neptunium, by W. H. Zachariasen, 12 p., (ANL-JJK-14B-16)

To be included in the NNES(MPTS).

The determination of the chemical identity and crystal structure of several sulfides and oxy-sulfides of plutonium and neptunium is discussed.

The list includes PuS, $Pu_{3-x}S_4$, Pu_2O_2S, NpOOS and Np_2S_3. Lattice dimensions and atomic positions are given.

This paper gives a brief account of crystal structure investigations which have been carried out on these sulfides of plutonium and neptunium: PuS, Pu_2S_3-Pu_3S_4, Pu_2O_2S, Np_2S_3 and NpOOS.

MDDC - 1538 The Negative Effect of Folic Acid on Irradiation Leukopenia in the Cat, by W. S. Adams and J. S. Lawrence. 13 p. (II-188-7487).

To be published in the American Journal of the Medical Sciences.

The hemopoietic tissues are extremely sensitive to a variety of toxic agents such as: thiouracil, the sulfonamides, certain heavy metals, dinitrophenol, amidopyrine and roentgen irradiation. This sensitivity is reflected by alterations within these tissues and many times in the corpuscular elements of the peripheral blood resulting in anemia, leucopenia and/or thrombocytopenia. The attempts of physicians to prevent or correct these disorders by the administration of a variety of drugs have met with dismal failure.

Following the isolation and synthesis of folic acid in 1945 and 1946 by Angier et al. This substance has been used widely in a variety of hemopoietic disorders. Watson et al. have suggested that this drug may be useful in the correction of irradiation leucopenia. They obtained beneficial effects in humans receiving regional roentgen treatment for various types of malignancy. Therefore it was thought important to investigate the possible prophylactic and therapeutic value of folic acid in cats receiving whole body irradiation. The situation which exists in human beings receiving regional irradiation is not strictly comparable to the whole body irradiation to which the cats were subjected. Also the figures as given by Watson et al. pertain to humans receiving repeated small doses of radiation in cases of malignancy whereas this report deals with apparently normal cats receiving 200r at a single exposure.

The prophylactic and therapeutic administration of folic acid to cats did not alter the occurrence or the magnitude of leukopenia caused by exposure to 200r whole body irradiation.

The report includes five graphs and three tables.

*MDDC - 1539 Alkali Plutonium(IV) Nitrates by H. H. Anderson. 6 p. (ANL-JJK-14B-61).

To be included in NNES(MPTS).

Plutonium(IV) and certain alkali ions react in fairly concentrated nitric acid to give crystalline precipitates of the general formula $R_2Pu(NO_3)_6$.

In most cases the precipitates could not be washed, either because of excessive solubility or because of decomposition. Chemical analyses justified formulation as the following: quinolinium plutonium(IV) hexanitrate, $(C_9H_7NH)_2Pu(NO_3)_6$; (di) cesium plutonium(IV) hexanitrate, $Cs_2Pu(NO_3)_6$; rubidium plutonium(IV) hexanitrate, $Rb_2Pu(NO_3)_6$; thallous plutonium(IV) hexanitrate $Tl_2Pu(NO_3)_6$; impure potassium plutonium(IV) hexanitrate, $K_2Pu(NO_3)_6$; hydrated pyridinium plutonium(IV) hexanitrate, $(C_5H_5NH)_2Pu(NO_3)_6.14R_2O$ approximately. The pyridinium salt melts at roughly 110°C and reforms crystals upon cooling.

All the double nitrates were pale-green crystalline solids.

Solubilities and details of preparations are given. The existence of these double nitrates is consistent with the concept of a complex hexanitratoplutonous acid, $H_2Pu(NO_3)_6$ in 3 M nitric acid or stronger. Certain aspects of the plutonium-nitric acid system are discussed.

*MDDC - 1540 Radiotoxicity of Injected SR^{89} for Rats, Mice, and Rabbits Part I. Introduction: Methods, by D. Anthony, K. Lathrop, and R. Finkle. 16 p. (CH-3844).

Inclusion in the NNES(MPTS). For part II see MDDC - 1363

The toxic effects and metabolism of radiostrontium (Sr^{89}-Sr^{90}) were studied. Determinations were made of the acute lethal doses for rats, mice, and rabbits, and of the comparative toxicity and metabolism following intraperitoneal and intravenous administration. Distribution studies of radiostrontium in various organs were made.

A method is described for handling and preparing radioactive strontium for administration to experimental animals. Procedures are given for preparing tissues and excreta for measurement of Sr^{89}-Sr^{90} with a Geiger-Müller counter, and for correcting these measurements for radioactive decay back to the time of injection.

Data are presented in tabular form.

MDDC - 1541 Analysis of Small Amounts of Chromium in UF_6, by H. A. Bernhardt, et al. 9 p. (A-4170)

To be published by the American Chemical Society.

A method of analysis has been developed in which the UF_6 is hydrolyzed and converted to the sulfate without loss of chromium. The chromous and chromic ion are oxidized with ammonium persulfate to the hexavalent state. The violet complex is formed by addition of an alcoholic solution of diphenylcarbazide and extracted with cyclohexanol. The light transmission of the cyclohexanol solution is read on a Beckman spectrophotometer and the concentration of chromium determined from a calibration curve.

By this method chromium was determined with an accuracy of $\pm 10\%$ using standard solution of chromium and chromium free uranium salts. A precision of $\pm 10\%$ was obtained with samples.

MDDC - 1542 Determination of Oxygen in Tank Nitrogen by its Conversion to Water and the Measurement of the Dew Point Temperature by H. A. Bernhardt, et al.11 p. (A-3645)

To be published in the Journal of the American Chemical Society.

A method was developed by which small concentrations of oxygen occurring in tank nitrogen may be determined by passing a mixture of nitrogen and hydrogen over "Carbide's Super Activated Copper Catalyst" at 325°C. in order to convert any oxygen present into water and measuring the resulting dew point temperature.

A schematic drawing of the dew-point apparatus, a scale drawing of the dew-point meter, and two graphs are included.

MDDC - 1543 The Thermodynamic Properties and Equilibria at High Temperatures of Uranium Halides, Oxides, Nitrates, and Carbides, by L. Brewer, L. A. Bromley, P. W. Gilles and N. L. Lofgren. 73 p. (BC-82)

Values of the thermodynamic data are given for the halides, oxides, nitrides, and carbides of uranium. Table I contains melting point, vapor pressure, and boiling point data. Table II gives vaporization equations and constants. Table III gives the thermodynamic data for the aqueous ions which were used in conjunction with the data for the solid substances. Table IV contains heats of formation and values of $(\Delta F - \Delta H_{298})/T$ from 298°K. to 1500°K. Table V contains the entropies at 298°K. and $-(F-H_{298})/T$ for the compounds. Table VI gives the heat content and entropy increases above 298°.

References are given for all data cited and a discussion of the chemistry of each compound is included with the references.

Twelve figures are presented to show the species that exist when a halide is heated at constant pressures of one atmosphere, 10^{-3} atm., and 10^{-6} atm.

This report, which was originally released on September 20, 1945, was revised on April 1, 1947 to agree with new data on the heats of formation of the aqueous ions. In addition, other extensive revisions were carried out.

MDDC - 1544 Study of sources of Contamination in the Analysis of Radioactive Materials by R. J. Gettens. 29 p. (LADC-463)

This study, mainly of air-borne chemical contamination, gives some quantitative data which may be of some interest to those who are concerned with all sources of contamination in fine analytical work. It shows that in a modern ventilated laboratory and under ordinary circumstances there is no great danger of contamination from air-borne sources.

The observations and data are reported under the following headings:

1. Residues from evaporation of water in the air-conditioning plant.
2. Composition of outside atmospheric dust.
3. Composition of dust found in the analytical laboratories.
   (a) Microscopic examination of dust samples.
   (b) Spectrochemical analysis of laboratory dust ash.
   (c) Quantitative chemical composition of laboratory dust ash.
   (d) Components of dust originating in the green composition floor tile.
4. Estimation of contamination by chemical elements in dust per unit area per unit time.
5. Dust contamination of copper electrodes in spectrographic analysis.
6. Dust contamination in open containers.
   (a) In small pyrex volumetric flasks.
   (b) In quartz dishes.
7. Mechanical factors contributing to the formation of building dust.
   (a) Dust contamination arising from floor polishing.
   (b) Dust from floor sweepings and dirt carried by canvas shoe covers.

MDDC - 1544 Study of sources of Contamination in the Analysis of Radioactive Materials by R. J. Gettens. 29 p. (LADC-463)

8. Miscellaneous sources of contamination.
   (a) From soap used in mopping floors.
   (b) From solids left by evaporation of mop water.
   (c) From nitrates deposited from nitric acid fumes.
   (d) From silica from ground stoppers and joints of quartz stills.

MDDC - 1545 Inelastic Scattering of Neutrons by K. I. Greisen. 27 p. (LADC-305)

To be published in the Physical Review.

This report describes a study of a method for locating the lowest energy level for inelastic scattering of neutrons by a given material. The method depends on the fact that if two counters have different dependence of sensitivity on energy, and are simultaneously exposed to the same neutron beam, the ratio of counts obtained gives a measure of the average energy. In the experiments performed, one of the counters contained boron, and the other hydrogen. The two counters were first exposed to the primary, monenergetic neutrons, and secondly to a mixture of primary and scattered neutrons. Inelastic scattering of the primary neutrons was indicated by an increase in the boron counts relative to the hydrogen counts.

The test was performed on lead, bismuth, gold and tungsten at a single primary energy of about 220 kilovolts, and was repeated on tungsten and lead at energies of about 570 and 130 kilovolts. Brief data were also taken on aluminum and carbon, in order to test the method under conditions where the energy loss by elastic scattering was known. These data only served to indicate that the method had sufficient sensitivity, and are not reported in detail. The results on the heavy elements indicate that, compared with lead (which was assumed to scatter entirely elastically), only the tungsten exhibited appreciable inelastic scattering. The effect with this element, however, was strong even at 130 kv primary energy.

MDDC - 1546 Mass Spectrographic Mass Assignment of Radioactive Isotopes by R. J. Hayden, 15 p. (ANL-AJD-204).

To be published in Physical Review.

One of the major problems in work with artificial radioactive isotopes is the determination of the masses of active isotopes. This may sometimes be accomplished by forming the activity in question by several methods and from different elements, and thus eliminating all possible mass values except one. With many activities this is not possible and in many cases the possibility of isomeric nuclei is present, thus making uncertain the masses of these active isotopes. The purpose of the work described in this paper was to determine definitely the masses of certain active isotopes whose previous mass assignments were uncertain. For this purpose a mass spectrograph was used in which the mass of the active isotopes was determined from its position in a spectrum of stable isotopes of known mass.

Characteristics of positive ion emission for various compounds on a tungsten filament are noted. Methods of analysis of mixtures of radioactive isotopes by mass spectrograph are described. The following mass assignments are made: 105-day yttrium, 88; 57-day yttrium, 91; 1-year ruthenium, 106; 275-day cerium, 144,; 3.7-year element 61, 147.

*MDDC - 1547 Determination of the Plus-Three Oxidation State of Plutonium and Notes on the Spectrophotometry of Plutonium and Uranium (based on CN-1324 and CK-1371) by J. C. Hindman, K. A. Kraus, J. J. Howland, Jr., and B. B. Cunningham. 21 p. (ANL-JJK-14B-2).

Included in the NNES(mpts).

Experiments are described which led to the identification of the plus-three oxidation state of plutonium. Through a series of qualitative reduction experiments involving both plutonium (IV) and plutonium (VI) it was found that an oxidation state of plutonium with oxidation number less than four exists and that this oxidation state is characterized by purple-violet aqueous solutions in hydrochloric, sulfuric and nitric acids. A method of spectrophotometric titration is described through which the oxidation state was identified as plutonium (III). The potential of the plutonium (III)/(IV) couple has been approximated through qualitative experiments and has been more precisely evaluated during a spectrophotometric titration of plutonium (IV) with ferrous ammonium sulfate.

A summary of some early spectrophotometric work involving plutonium solutions in in the various valence states and of some uranium solutions is also given.

MDDC - 1548 Further Measurements of Polarized Neutrons by D. J. Hughes. 4 p. (ANL-HDY-352).

For presentation at a meeting of the Physical Society held in Chicago December 29-31, 1947.

Recently a series of measurements have been made concerning double transmission effects and depolarization of neutron beams. The double transmission effect is obtained by passing a neutron beam through two blocks of iron, the first block acting as the polarizer, the second as the analyzer for the polarization. When the blocks are magnetized in the same direction, the intensity of the transmitted beam is increased, and if the direction of magnetization in the second block is then reversed, the intensity will decrease. Actually, the final intensity with crossed magnetic fields will be the same as the intensity when both magnets are off if the blocks are of equal size and both are magnetized to complete saturation. Previous measurements of the double transmission effect have shown small decreases of intensity when the field is reversed in the analyzer, but have never shown the large effects expected by theory.

Double transmission effects that are completely in accord with the theoretical expectations have been obtained. The main difficulty in obtaining the full double transmission effects was found to be that of insuring that the neutrons would not reorient themselves in moving from the polarizer to the analyzer magnet. The magnetized currents were symmetrized so that the field acting on a neutron moving from polarizer to analyzer was accurately perpendicular to the direction of motion, except for a very small region (about 3 mm) where the field "flipped" by 180^{o}. With the field thus symmetrized, the double transmission effects were fully as large as that predicted and for instance, with 2 cm blocks a double transmission effect of about 30% was observed.

Depolarization of the neutron beam between the polarizer and analyzer can easily be demonstrated and measured by the change in the double transmission effect which results from the depolarization.

It has been found that various stray fields do not depolarize the neutron beam but merely cause the neutrons to follow the direction of the field in an adiabatic manner without changing the net polarization of the beam. However, the transmission of the polarized beam through the thin sheet of magnetized iron causes complete depolarization.

Preliminary measurements show that a sheet of steel about three mils thick completely depolarizes the neutron beam, and that the rate of depolarization as measured by thinner sheets indicates a domain size for the particular sample used as about 2×10^{-3}cm.

*MDDC - 1549 Half-Life of U^{233} by L. I. Katzin. 1 p. (ANL-HDY-324).

This article is an abstract and the whole text is reproduced herewith.

The following information has been declassified for use in a lecture December 26 before the AAAS:

The isotope U^{233} decays by emission of alpha particles with a half-life of 1.62×10^5 years.

MDDC - 1550 Induction of Mutations in Paramecium aurelia by Beta Radiation, by R. F. Kimball, 11p

To be published in the Anatomical Record.

Animals of stock 90, variety 1 of Paramecium aurelia were exposed to doses ranging from 5,000 to 20,000 r.e.p. of beta radiation from radioactive phosphorus plaques and irradiated animals isolated. The doses used had no lethal effect upon the animals so long as they multiplied vegetatively. However, when their descendants were made homozygous by autogamy, a large fraction of the exautogamous clones were non-viable or poorly viable. Since effects on viability first appeared after homozygosity was induced, it seems probable micronuclear mutations were responsible for them This conclusion is supported by the results of backcrossing irradiated to unradiated animals and subsequently inducing autogamy in the backcross clones. The dosage relations suggest that chromosomal aberrations as well as gene mutations were involved. By irradiating timed stages in the fission interval, evidence was obtained that a stage near the beginning of fission is relatively insensitive to the mutation inducing action of the radiation.

MDDC - 1551 Determination of HF in Gas Mixtures By the Differential Flow Analyzer, by S. S. Kirslis, E. R. Grilly, H. A. Bernhardt, and E. Staple. 21 p. (A-3644)

To be published by the American Chemical Society.

The theory of this method is described in a report by C. F. Hewlett of Kellex Corporation entitled: "A Differential Flow Analyzer for HF-N_2 Mixtures". The work described in the present report is a continuation and development of the above method, particularly with a view to its application to mixtures containing fluorine. The theoretically derived working-curve given by Hewlett was checked with HF - N_2 mixtures which were standardized by wet chemical analysis. The empirical, calibration curves gave differential pressure readings up to 7% higher than Hewlett's theoretical calibration curve. This discrepancy is not fully explained.

For the determination of HF in gas mixtures which may contain fluorine, HF, N_2, and O_2, a physical method using an all-metal system was thought desirable because HF and fluorine are extremely reactive and corrosive, making them difficult to handle by ordinary chemical methods. The method also has the advantage that it uses a flowing bridge system which minimizes the effects of corrosion and absorption. Since the essential feature of this method is the drop in pressure caused by the adsorption of HF from a gas mixture by means of a sodium fluoride trap, the reading is not affected by components of the gas mixture which are not absorbed by sodium fluoride. Therefore, fluorine does not interfere with the determination.

The viscosities of pure HF and of a mixture containing 7.5 mol per cent HF in N were determined roughly and found to be approximately 0.7 and 0.99 that of N respectively.

MDDC - 1552 Rotary-Leaf Filter by Myron Kratzer. 2 p. (LADC-458).

Disposition as required for use in research, development, or manufacturing work.

The object was to provide a filter with a high rate of filtration which is automatically prevented from clogging normally caused by caking of a residue

In filtering fluid slurries, the rate of filtering is reduced greatly by residue caking on the filter and clogging it. The present invention consists of a single hollow filter disc (or a multiplicity of hollow filter discs) which is covered with a porous porcelain filter, sintered glass filter or filter paper, said filter being properly secured to the face of a hollow filter disc. A filter disc is suspended on the end of a suction or draw-off tube. The filtrate is drawn off by placing a continuous vacuum on the draw-off tube. A precipitate is prevented from forming on the filter by rotating the filter disc by means of a motor attached to the draw-off tube and continuously throwing the precipitate off the face of the filter by centrifugal force. Optimum depth of operation and speed of rotation can be determined by the operator for various precipitates.

A drawing is attached.

MDDC - 1553 Load-Life Characteristics of Fixed Composition Resistors by G. Lansman. 13p. (CP-2746)

Due to the exacting design requirements of electronic equipment, it has become necessary to accurately determine the properties of electronic components. This report discusses the load-life characteristic of the most generally used fixed-composition resistors. The information given here does not represent a final statement of these characteristics.

It is known that resistors under load in circuits exhibit noticeable resistance variations against time. The load-life tests were devised as a measure of this characteristic. Experience has shown that these tests give results that may be compared to actual operating conditions.

The following general statements hold true.

1. External temperature has a decided effect on resistor drift. The greater the external temperature, the greater the drift for a given period of time.

2. The largest rate of change of total drift of a resistor occurs in the first days of its operation.

3. For equal wattage ratings and conditions of operation, Globar type-A exhibits less drift than any of the other resistors tested.

4. Centralab type 310 and A-B type EB drift characteristics rank second best.

5. Erie type 524 resistors are unsatisfactory under conditions of rated load.

6. Present data tend to indicate that Continental's load-life characteristic is unsatisfactory.

7. IRC resistor behavior remains unpredictable with the present data.

8. More data must be obtained on Speer resistors before definite conclusions can be reached.

*MDDC - 1554 , Resistance-temperature Characteristics of Fixed Composition Resistors by G. Landsman, 13 p. (CP-2746).

Disposition as required for the use in research, development, and manufacturing work.

Among the most important resistor and potentiometer characteristics is the resistance-temperature characteristic. To engineer circuits properly, it is necessary to be able to predict accurately variations of resistance with temperature. Considering that temperature rises as high as 55°C ambient above have been measured, it is not surprising that this characteristic is often limiting.

The resistors were mounted in a temperature-regulated oven near the bulb of the thermometer being used to measure resistor (oven) temperature. Resistance was measured at 25°C (base ambient temperature). The resistors were then maintained at the successive temperatures indicated on the curves. Resistance measurements were made thirty minutes after the resistors had come to the indicated temperature. After the top temperature had been reached, the resistors were allowed to return to 25°C. The resistors were then measured again not less than one hour after they had cone back to the base-ambient temperature.

The results are summarized as follows:

1. For low temperature operation of general circuit operation up to approximately 70C, A-B resistors (insulated and non-insulated types) and the Erie resistors have the most favorable resistance-temperature characteristics.

2. The Globar resistance-temperature characteristic is the most nearly linear. In magnitude of its temperature coefficient it follows A-B and Erie.

3. For high-temperature resistance-temperature stability, the Stackpole resistor appears to exhibit the best characteristic.

4. The temperature coefficient of Centralab resistors is larger than any of the other resistors tested. Where resistance-temperature effects are limiting, the Centralab resistor is not acceptable.

MDDC - 1555 Determination of Plutonium in Human Urine by W. Langham, et al. 10 p. (LADC-435)

To be published in the Journal of Biological Chemistry.

A method is given for the analysis of 24 hour urine samples collected from personnel exposed to plutonium. The method consists of evaporating the urine sample to dryness and ashing out the organic matter with concentrated nitric acid. After the ashing procedure, the plutonium is carried from the ash solution by hydroxide precipitation. The hydroxide precipitate is dissolved in dilute acid and the plutonium extracted by means of a cupferron extraction. The cupferron extract is wet-ashed with perchloric acid and the plutonium carried down with lanthanum fluoride. The lanthanum fluoride precipitate is transferred to a platinum disk and counted in an alpha counter.

A statistical interpretation of results and the basis of the 1 microgram tolerance is given.

MDDC - 1556 A Mass Spectrograph for Radioactive Isotopes by L. G. Lewis and R. J. Hayden. 22 p.

To be published in the Physical Review.

The construction of a 60° mass spectrograph for the identification of the masses of active isotopes is described. Methods of analysis with this spectrograph are given. Mass analyses of 55-day strontium, of 40-hour lanthanum, and of a mixture of fission products in the rare-earth range are described.

Mass	Ion	Half-life
137	Cs^{137+}	33 yr.
147	61^{147+}	3.7 yr.
151	Sm^{151+}	long
155	Eu^{155+}	2 yr.
157	$Ce^{141}O^{16+}$	28 da
159	$Pr^{143}O^{16+}$	13.8 da.
160	$Ce^{144}O^{16+}$	275 da.
163	$61^{147}O^{16}+$	3.7 yr.
165	$61^{147}O^{18+}$	3.7 yr.

MDDC - 1556 - A Mass Spectrograph for Radioactive Isotopes by L.G. Lewis and R.J. Hayden. 22 p.

Mass	Ion	Half-life
167	$Sm^{151}O^{16+}$	long
156	$La^{140}O^{+}$	40 hr
90	Sr^{90+}	25 yr.

*MDDC - 1557 Cyclotron Frequency-Modulation by K.R. MacKenzie. 1,p. (BP-141)

To be published in the Bulletin of the American Physical Society.
This article is an abstract and is presented here in its entirety.

A method of modulation with a frequency range of 2.4 to 1 has been developed in the Radiation Laboratory, making it possible for the 184-inch cyclotron to accelerate either protons or deuterons in the near future. The system utilizes a capacitor consisting of a rotor with 6 rows of blades, 50 blades to a row, which mesh with two stator rows. One stator row is held at one end of a large rectangular cross-section transmission line, 1/4 wavelength long, which is grounded at the other end. The other row is held at the end of a similar line which is connected to the dee. When fully meshed the whole system resembles a 1/4 wave line. At the high frequency limit the system oscillates in approximately three 1/4 wave sections with twice the dee voltage across the capacitor. Power is supplied by grounded grid-tubes coupled to the resonant system by two lines whose lengths are adjusted to limit amplitude modulation to around 20%.

MDDC - 1558 Diffraction Effects in Neutron Attenuation Measurements by E.M. McMillan and D.C. Sewell. 8 p. (UCRL-13)

To be published in the Physical Review.

All errors due to diffraction effects in a neutron attenuation experiments are computed. Also a special experiment to measure the forward intensity of diffracted neutrons from lead and copper is described, and the results given. These agree with the theoretical values.

MDDC - 1559 X-Ray Structural Studies of the Tetrachlorides of Uranium and Thorium by C.L. Mooney. 7 p. (ANL-FWHZ-132)

To be presented before the American Physical Society and published in Physical Review.

The crystal structure of thorium tetrachloride and of uranium tetrachloride has been determined from X-ray powder diffraction photographs.

The structures are isomorphous. The lattice is body-centered tetragonal; the space group symmetry D^{19}_{4h} — I4amd. The unit cell, with respective dimensions as follows, contains four molecules:

$ThCl_4$ $a_1 = 8.472 \pm .003$ Å $a_3 = 7.468 \pm .003$ Å ρ (calc) = 4.60 gm/cm^3

UCl_4 $a_1 = 8.296$ .009 Å $a_3 = 7.487 \pm .009$ Å ρ (calc) = 4.866 gm/cm^3

Positions have been found for the atoms such that the calculated intensities are in good agreement with observations.

MDDC - 1560 **Electromagnetic Deflector for the Beam of the 184-Inch Cyclotron by W.M. Powell, et al. 13 p. (BP-138).**

To be published in the Physical Review.

Description of the design and performance of an electromagnetic deflector for removing the deuteron beam from the 184-inch cyclotron are given. A pulsed electric deflector pushes the beam inward so that it rebounds after one revolution a distance of two inches. At this point it enters a magnetic shield which reduces the strength of the magnetic field in the path of the beam sufficiently to permit it to leave the magnet. Certain percentage of the circulating beam appears in the external beam.

MDDC - 1561 Some Procedures for the Preparation of Highly Purified Adenosine Triphosphate, by A. Rothstein 1p.

To be published in the Journal of Biological Chemistry or in Archives of Biochemistry

With Curare. When animal is under deep anesthesia fifteen units of intercostin (Squibb) are rapidly injected intravenously. As much blood as possible is drained out. The abdominal and intercostal muscles can be used as well as the leg and back muscles.

The use of curare probably permits more latitude in preparation of the animal, but it is doubtful whether the yield of A.T.P. per kilogram of muscle is materially increased.

Preparation of Adenosine Triphosphate from Yeast. Fresh Baker's Yeast is washed twice with distilled water, using the centrifuge. A rather low speed of centrifugation must be employed.

The rest of the procedure is the same as the procedure used for isolating A.T.P. from muscles, except that 20 per cent trichloracetic acid is substitued for eight per cent trichloracetic acid

Preparation of Adenosine Triphosphate Containing Radioactive Phosphorous. Ten million counts of P_{32} in less than a milligram of sodium phosphate were injected intravenously into a rabbit. The animal was then caused to exercise strenuously by placing it in a tub of water and allowing it to swim for thirty minutes. After this the animal was allowed to rest for two hours.

Barium A.T.P. was isolated from the animal by the regular procedure. The animal was prepared by the use of nembutal and curare. The recovery of radioactive phosphate in the A.T.P., as well as specific activity of the phosphate groups are given.

Purity of Various Adenosine Triphosphate Preparations.

Phosphates: A modification of the Fiske and Subbarow method which is found in Manometric Methods by Burris, Umbreit, and Stauffer.
Nitrogen: A micro-Kjeldahl method according to Johnson.
Barium: This was determined gravimetrically according to the method in Textbook of Quantitative Inorganic Analysis by Kolthoff and Sandell.
Pentose: A modification of the method of Mejbaum was used which appears in Manometric Methods by Burris, Umbreit, and Stauffer.
The absorption spectrum of A.T.P. is shown.

MDDC - 1562 The Mechanism of Action of Uranium on Carbohydrate Metabolism of Yeast by A. Rothstein 31 p. (II-188-7466).

To be presented at a seminar in the Biology Department at the University of Rochester.

Although the kidney is the organ of prime interest in studying the effects of uranium on mammals, technical difficulties preclude a thorough study of the precise mode of action of uranium on the kidney cells. To avoid some of these difficulties a study was undertaken of the action of uranium on yeast cells with the hope that some of the findings might be applicable to kidney cells as well. This report constitutes a preliminary survey of work with the yeast cell.

Muntz, Singer, and Barron found that U in low concentrations (of the order of 10^{-4} to 10^{-5} M) completely inhibited the oxidation of glucose as measured by O_2 consumption and glucose consumption under anoerobic conditions except in the presence of bicarbonate, but only partially inhibited the metabolism of ethyl alcohol and sodium acetate. The inhibition of U could be relieved by addition of phosphate, bicarbonate, citrate and adenosine-triphosphate. The action of U on the enzymes in yeast maceration juice was not similar to that on intact cells in that phosphate did not cause the reversal of inhibition. Other micro-organisms such as Ps aeruginosa E.coli and M. lysodeikticus also showed inhibition of glucose but at higher U concentrations. In the case of the latter organism, a maximum of only 22% inhibition is attained even at relatively high U concentrations. They suggested that U combined with certain accessory groups present on the cell surface necessary for glucose utilization.

The experimental findings of these authors were confirmed during the initial stages of this investigation and because these results were very promising, more extensive quantitative studies were undertaken to determine if possible the exact site of action of U in the schema of carbohydrate metabolism and to establish whether the uranium acted at the surface of the cell or whether it penetrated into the cell and acted within the cytoplasm.

There appears to be surface action of U, but with very high concentrations of $UO_2(NO_3)_2$ (up to 10^{-2}M), some U does penetrate into the cell. The U in the cell is probably tied up as bicarbonate and phosphate complex.

Uranium seems to act on one or some of the early stages of glucose metabolism. It also has other measurable effects on the yeast cell. There seems to be a marked change in permeability as indicated by a more rapid leakage of base from the cells. There is leakage of traces of phosphates, which does not occur in absence of U. Other changes undoubtedly occur.

Schema of glucose metabolism, schema of carbohydrate metabolism, and seventeen graphs are included.

MDDC - 1563 The Eight New Synthetic Elements by G. T. Seaborg, 3 p. (UCRL-9).

To be published in the American Scientist.

This report consists of excerpts from a talk to be presented as Sigma Xi National Lecture of meeting of the American Association for the Advancement of Science in Chicago, Illinois on December 30, 1947.

A discussion is given of elements Tc^{99}, 61^{147}, and Fa (221 and 223).

Any future elements which might be discovered must have atomic numbers greater than 96, that is, must lie in the "transcurium" region.

MDDC - 1564 The Determination of Small Amounts of Nitrate in U_3O_8 by E. Staple, E. Marshall and W. Simon. 14 p. (A-3634).

To be published in the Journal of the American Chemical Society

This report describes a method which would permit the determination of nitrates in the 0-100 part per million range with a reasonable precision (10% of the nitrate content).

A first attempt was based on the reduction of the nitrate to ammonia with Devarda's Alloy. This method was found to be erratic with such small quantities of nitrate in the presence of uranium. A method based on the isolation of the nitrate from the oxide by distillation followed by a colorimetric determination of the nitrate in the distillate as the Fe(NO)++complex was developed. This method has been found to have the required range and precision mentioned above. This method is obviously not applicable when volatile interfering substances are present.

MDDC - 1565 The Determination of the Composition of Fluorine-Nitrogen Mixures by the Thermal Conductivity Method and the Construction of a Field Apparatus for Such Analyses by E. Staple and E.R. Grilly, 14 p. (A-3635).

To be published by the American Chemical Society.

A thermoconductivity apparatus has been constructed for analyzing fluorine-nitrogen mixtures. Details on the construction, calibration and operation of such an instrument are given. Using this apparatus it is possible to analyze mixtures containing from 0– 17 percent fluorine in the presence of nitrogen with a precision of ± 0.12 percent.

Six diagrams of apparatus and circuit used and the calibration curve for the thermal conductivity apparatus are included.

MDDC - 1566 Short-Lived Halogen Fission Products by N. Sugarman. 36 p. (ANL-NS-272).

To be presented before a meeting of the American Association for the Advancement of Science and to be published in the Journal of Chemical Physics.

Half-life values have been determined for some short-lived Br and I fission products. The half-lives found for Br^{87} and Br^{88} by extraction of the Kr daughter activities were 56 sec. and 16 sec. respectively, on the basis of a 3.0-min. half-life for Br^{85}. Attempts to measure the half-lives of Br^{89} and Br^{91} by extraction of the descendant Sr activity were unsuccessful because of the absence of activity. The identity of half-lives of Br^{87} and the 55.6-sec. Br delayed neutron-emitter makes it probable that the mass assignment of the delayed neutron emitter is 87.

The half-life of I^{137} was found to be 19 ± 2 sec. by extraction of Xe^{137}, on the assumption of constant chemical yield of the Xe extraction. The half-life of I^{137} found by comparison of the activity of Xe^{137} with that of Xe^{138} depends strongly on the half-life of I^{138} which is known only roughly to date as ~ 6 sec. Extractions of Ba^{139} led to determination of the half-life of I^{139} as 2.6 sec. The absence of Ba^{140} activity in AgI precipitates made it impossible to determine the half-life of I^{140}. Because of the agreement in half-lives of I^{137} and the 22.0-sec. I delayed neutron-emitter it is probable that the two are identical.

MDDC - 1567 A New Radioactive Series--The Protoactinium Series by M. H. Studier, E. K. Hyde. 18 p. (ANL-HDY-323).

To be presented before the American Association for the Advancement of Science, published as a thesis, and submitted for publication in the NNES (MPTS).

The existence of a branch of the uranium-radium series consisting of a whole series of isotopes is reported in this paper. This new series was produced by a d,4n and an α,p5n (with probably some contribution from an α,6n) reaction in bombardment of thorium metal. The isotopes of the new "protoactinium" series (name suggested from its first number) were found to be the following:

$$Pa^{230} \xrightarrow[17d]{\beta-} U^{230} \xrightarrow[20.8\ d]{\alpha(5.86Mev)} Th^{226} \xrightarrow[30.9\ m]{\alpha(6.3Mev)} Ra^{222}$$

$$\xrightarrow[38\ s]{\alpha(6.5\ Mev)} Em^{218} \xrightarrow[0.019]{\alpha(7.1\ Mev)} RaC' \xrightarrow[1.5 \times 10^{-4}\ s]{\alpha} RaD$$

$$\xrightarrow[22y]{\beta-} RaE \xrightarrow[5\ d]{\beta-} RaF \xrightarrow[140\ d]{} RaG \quad \text{(Stable)}.$$

The energies of the alpha particles of the members of the series were determined with a multi-channel differential pulse analyzer. A rigorous assignment of energies was possible only for RaC' and U^{230}, the other energies being tentatively assigned to the isotopes in the inverse order of their half-lives.

MDDC - 1568 · Effect of Energy on the Mass-Yield Curve of Thorium by A. Turkevich, 16 p. (ANL-HDY-349).

To be presented before a meeting of the American Association for the Advancement of Science.

Some gross features of the fission product distribution curve in Th^{232} fission were investigated radiochemically. Pile neutrons (2 ~ 2 Mev) and Li+D neutrons (13-19 Mev) were used. Asymmetrical division is the most probable mode of fission in both cases. Symmetrical fission has a yield of about $\frac{1}{100}$ of the most probable mode with pile neutrons, and about $\frac{1}{15}$ the most probable in the case of the high energy neutrons. A comparison of the yields from thorium fission is made with the well known yields in $uranium^{235}$ fission, where the yield of symmetrical fission is $\frac{1}{600}$ that of the most probable.

MDDC - 1569 A New Colorimetric Method For Determining Traces of Beryllium by A. L. Underwood 14 p. (II-188-7463).

To be published in a journal.

A colorimetric method for the determination of beryllium in the amounts of 0.2 to 8 micrograms has been developed, employing an alcoholic extract of powdered alkanet root. The effects of pH, dye concentration, time of standing, heating, and several common ions have been studied. The accuracy of the method as applied to pure beryllium solutions is quite satisfactory, standard deviations of about 5% having been obtained with a large number of synthetic "unknowns".

The fact that the reagent is an extract of a crude root and not a solution of a pure chemical compound is clearly disadvantageous, since variations in the amount of active material may be expected in preparations from different stocks of starting material. In view of the encouraging results reported the method clearly warrants further study for improvements and applications.

MDDC - 1570 The Lymphocyte Relation of Adrenal Cortical Hormone to Lymphoid Tissue and Lymphocytes by W. N. Valentine, C. G. Craddock, Jr. 54 p. (II-188-7500).

To be published in Medicine.

Experimental studies were made on the influence of adrenal cortical extract on the numbers of thoracic duct lymphocytes and rate of flow of thoracic duct lymph in the cat.

Thoracic duct cannulations were performed on nine normal control animals receiving adrenal cortical extract after two hourly baseline studies, and on nine bilaterally adrenalectomized animals also receiving adrenal cortical extract after a similar period of baseline determinations.

Lymph was collected in every instance in hourly volumes and the latter recorded, and lymphocytes per cubic millimeter and total lymphocytes in each hourly specimen determined from total and differential leukocyte counts made on the lymph.

In all groups the determination of the first two Hours, specimens or of the specimen for the second hour only were used as a standard of reference and the values for lymph volume, lymphocytes per cubic millimeter and total lymphocytes during each succeeding hour expressed as a ratio or percentage of the standard of reference. The findings using both standards of reference are reported.

The majority of experiments were continued for eight hours. Thus data were available for six hours after administration of hormone to the treated group.

The data for the control and for the two treated groups were statistically compared. It was concluded that under the conditions of this experiment no significant effect of adrenal cortical extract administered subcutaneously in large doses was demonstrable on either the rate of flow, number of lymphocytes per cubic millimeter of lymph, or total lymphocytes per hour of thoracic duct lymph.

Data are presented on the total and differential leukocyte counts before and after bilateral adrenalectomy in five cats. It was concluded that the average absolute lymphocyte counts in the animals studied did not change significantly after adrenalectomy. Neutrophilic leukocytosis followed the operative procedure of adrenalectomy.

In the second part of the report the medical literature relating to the subject of pituitary-adrenal cortical control of lymphoid tissue and function is reviewed and discussed.

MDDC - 1571 The Chemical Consequences of Isomeric Transition in Te by R. R. Williams. 18 p.

To be published in the Journal of Chemical Physics and included in the NNES (MPTS).

It has been demonstrated that the nuclear process of isomeric transition, when proceeding by the mechanism of internal conversion, can bring about chemical changes in the atoms involved. Such changes have been studied with the nuclei Te^{127}, Te^{129}, and Te^{131}. Chemical separations of the gound states from the excited states of these nuclei have been observed under various conditions and a consistent, if superficial, picture of the process synthesized. Evidence has also been advanced to indicate that the maximum efficiency of the chemical separation of these nuclear isomers can be taken as a measure of the degree of conversion of the isomeric transitions.

MDDC - 1572 Crystal Radii of the Heavy Elements by W. H. Zachariasen, 5 p. (ANL-FWHZ-141)

To be published in the Physical Review.

Crystal radii for the trivalent and tetravalent ions of the heavy elements from actinium to americium as deduced from crystal structure data are listed and briefly discussed.

MDDC - 1573 The UCl_3-Type of Crystal Structure by W. H. Zachariasen, 3 p. (ANL-FWHZ-139).

To be published in the Physical Review.

The UCl_3-type of structure was observed in the course of war research within the Manhattan Project. The crystal structure of the prototypic compound UCl_3 was first described in reports issued within the Manhattan Project in January and March 1944.

Since that time seventeen additional compounds have been found to crystallize with the UCl_3 type of structure. UCl_3 is hexagonal with two molecules per unit cell. The lattice periods are:

$a_1 = 7.428 \pm 0.003$ Å $\qquad a_3 = 4.312 \pm 0.003$ Å

corresponding to a calculated density of $\rho = 5.51$. The density $\rho = 5.44$ is reported in the literature.

The space group is $C6_3/m$ (C_{6h}^2) and the atomic positions are:

2 U in $\pm$ (1/3 2/3 1/4)
6 Cl in $\pm$ (x y 1/4) ($\bar{y}$, x-y, 1/4) (y-x, $\bar{x}$, 1/4)

The parameter values are found to be
$x = 0.375 \pm 0.014$, $\qquad y = 0.292 \pm 0.014$

Each uranium atom is bonded to nine chlorine atoms, three at a distance of U-Cl = 2.95 Å and six at U-Cl = 2.96 Å. The closest distance of approach of two chlorine atoms is Cl-Cl = 3.45 Å.

Lattice dimensions are given for the following compounds in additon to UCl_3: $AcCl_3$, $NpCl_3$, $PuCl_3$, $AmCl_3$, $LaCl_3$, $CeCl_3$, $PrCl_3$, $NdCl_3$, $AcBr_3$, UBr_3, $NpBr_3$, $LaBr_3$, $CeBr_3$, $PrBr_3$, $La(OH)_3$, $Pr(OH)_3$, $Nd(OH)_3$.

*MDDC - 1574 The Preparation and Properties of the Plutonium Chlorides and Oxy-Chlorides, by B. M. Abraham, et al 37 p. (ANL-JJK-14B-41)

To be included in the NNES(MPTS).

The preparation of $PuCl_3$ is discussed. Preparation by treatment of plutonium metal with chlorine, by vapor phase chlorination of PuO_2 with CCl_4 or $S_2 + Cl_2$, by liquid phase chlorination with PCl_5, S_2Cl_2 + ca. 1% Cl_2 or CCl_4 + ca. 1% Cl_2, and by dehydration of a $PuCl_3$ solution in a stream of HCl are described in detail. A comparison is made of the thermodynamic effectiveness of various chlorinating agents.

Attempts to make $PuCl_4$ by treatment of $PuCl_3$ and $PuBr_3$ with liquid Cl_2 at 170° C gave rise only to $PuCl_3$. Dehydration of $PuCl_4$ solution in a stream of HCl gave rise to $PuCl_3$ plus unidentified phases but not anhydrous $PuCl_4$. It is concluded that solid $PuCl_4$ is unstable relative to decomposition into $PuCl_3$ and Cl_2. Correlation of the data for the equilibrium between UCl_4 and UCl_3 with the potentials for the (III, IV) couples for both uranium and plutonium supports this conclusion. However both experimental and theoretical considerations indicate that when chlorine gas is passed over solid or liquid $PuCl_3$ in the temperature range of 600°C-800°C, $PuCl_4$ molecules are formed in the gas phase. These $PuCl_4$ molecules decompose on a colder surface to give a condensed phase of $PuCl_3$ and chlorine gas.

Exposure of $PuCl_3$ to water vapor at varying pressures converts it to a mono-, a tri-, or a hexa-hydrate. Plutonium oxychloride is synthesized by heating $PuCl_3 \cdot 6H_2O$ in a sealed tube or by treating PuO_2 or $PuCl_3$ at 650°C with the vapor mixture obtained by bubbling H_2 through 38% aqueous HCl.

This paper reports studies of the methods of synthesis of $PuCl_3$ and its hydrates, of PuOCl, and of the attempts to make $PuCl_4$. The determinations of the melting point and the vapor pressure curve of $PuCl_3$ and the studies of its reduction to Pu metal are described in separate reports.

MDDC - 1575 The Vapor Pressure and Heat of Sublimation of Graphite, by L. Brewer, P. W. Gilles, and F. A. Jenkins. 33 p. (BC-87)

For publication in the Journal of Chemical Physics.

The heat of sublimation of graphite and the heats of dissociation of CO and C_2 which have been the subject of much controversy in recent years, have been unambiguously established by the direct determination of the total vapor pressure of graphite by an equilibrium effusion method and by the determination of the partial pressure of C_2 (gas)in equilibrium with graphite.

The heat of sublimation of graphite to C(g) is found to be ΔH_O = 170.39 ± 0.20 kilocalories per mole at O° K. The heat of sublimation of graphite to C_2 (g) is found to be ΔH_O = 226.6 ± 7 kilocalories per mole. The heats of dissociation of C_2 and CO have been shown to be 4.95 ± 0.30 and 11.109 ± 0.01 electron volts, respectively. The accomodation coefficient of carbon gas on graphite at high temperatures is found to be about 0.3 and vaporized carbon gas is shown to be in the ^3P ground electronic state.

MDDC - 1576 Relative Effectiveness of Different Intensities of Gamma Radiation in Retarding Mitosis in the Grasshopper Neuroblast, by J. G. Carlson, M. L. Snyder, and A. Hollaender. 4p.

For oral presentation before a meeting of the American Association for the Advancement of Science held in Chicago in December, 1947, and for publication in the Anatomical Record.

Eggs of the grasshopper, Chortophaga viridifasciata (De Geer), containing embryos at an age equivalent to 14 days at 26° C were exposed to different doses of gamma radiation administered at different intensities. Immediately following the end of treatment these embryos and untreated controls were made into hanging-drop preparations for continuous observation under the microscope. When the total dose administered was 8r or 32r, the effect on cell division resulting from treatment at an intensity of 32r-per-minute was not significantly different from that resulting from treatment at 2r-per-minute. When the total dose was 128r, however, the 32r-per minute intensity was considerably more effective in retarding mitosis than the 2r-per-minute intensity. Studies over a greater intensity range are now in progress

*MDDC-1577 The Metabolism of Peptides of Asparagine, by C. E. Carter 1 p.

For oral presentation before a meeting of the Federation of American Societies for Experimental Biology and for publication in the Federation Proceedings.

This article is an abstract and is given here in its entirety.

Enzymes capable of hydrolyzing the peptide bond of glycyl l-asparagine without attacking the amide groups have a high activity and wide spread distribution in mammalian tissues. The optimum effect exhibited by this system is at pH 8. Liver and kidney extracts are the most potent sources of the enzyme, and in dilute solution effect the complete hydrolysis of the peptide in 2.8×10^{-2} M substrate in 20 minutes.

Dialysis does not inactivate the enzyme system and there is no specific metal activation, or anion effect such as has been described in the desamidation of glutamine and asparagine.

Leucyl asparagine is metabolised at the same rate as glycyl asparagine. Chloroacetyl asparagine, α-bromisocapronyl asparagine, are metabolized by aqueous tissues extracts but at a much slower rate.

Hydrolysis of the peptide bond has been followed manometrically by the chloramine T reaction and by the ninhydrin reaction.

A purification of the enzyme system has been effected from rat liver by ammonium sulfate fractionation of aqueous extracts.

*MDDC - 1578 The Preparation and Properties of Plutonium Tribromide and Oxy-Bromide, by N. R. Davidson, et al. 22 p. (ANL-JJK-14B-40)

To be included in the NNES(MPTS).

The preparation of plutonium tribromide is discussed. Preparation by treatment of plutonium metal with bromine, by hydrobromination of PuO_2, by treatment of PuO_2 with a sulfur-bromine vapor mixture at 800°C to form sublimed $PuBr_3$, and by dehydration of a $PuBr_3$ solution in a stream of HBr are described in detail. In connection with this last method it was noted that an aqueous solution of $PuBr_4$ is reduced to $PuBr_3$ by aqueous HBr at temperatures such that the bromine formed is boiled out of the solution.

Solid anhydrous $PuBr_4$ is not formed when $PuBr_3$ is heated in bromine vapor and it is believed that solid $PuBr_4$ is unstable relative to decomposition into $PuBr_3$ and bromine. However there is some evidence that $PuBr_4$ molecules are formed in the gas phase when bromine vapor is passed over $PuBr_3$ at 800°C. The $PuBr_4$ molecules decompose on a cold surface to form a condensed phase of $PuBr_3$ and bromine gas.

Hexahydrated $PuBr_3$ is formed when the anhydrous salt is exposed to air. The hexahydrate deliquesces in air. Some preliminary studies of the equilibrium in the reactions:

$$PuO_2 + \tfrac{1}{2}H_2 + HBr = PuOBr + H_2O$$

and

$$PuOBr + 2HBr = PuBr_3 + H_2O$$

are reported. The recommended method of synthesis of PuOBr is to treat PuO_2 at 750°C with the vapor mixture obtained by saturating a hydrogen-hydrogen bromide mixture (partial pressure 1/3 atmosphere) with water at room temperature.

*MDDC - 1579. Electrolysis of Non-Aqueous Solutions of Uranium Bromides; and Reaction of Alkali Metals with Uranium Bromides in Liquid Ammonia, by E. D. Eastman and B. J. Fontana. 14 p.

To be included in the NNES(MPTS).

Attempts to electrodeposit metallic uranium from solutions of uranium tetrabromide in a wide variety of organic solvents and in water were in general unsuccessful. Only in formamide, acetamide and ethyl alcohol solutions was any metallic uranium produced, and then only with extremely low current efficiency. The failure of the electrolytic process can be attributed either to very low solubility of the tetravalent uranium salt or to the reactivity of the intermediate trivalent uranium ion. A brief survey of the stability of uranium salts in formamide, acetamide and ethyl alcohol is given. The investigation is concluded with a study of the behavior of the tri- and tetravalent uranium bromide solutions in liquid ammonia and the action of reducing metals on these solutions.

MDDC - 1580 Proton Angular Distribution for 90 Mev Neutron-Proton Scattering, by J. Hadley, C. E. Leith, and H. F. York. 4 p. (UCRL-5)

For publication as a Letter to the Editor of the Physical Review.

See also MDDC-1421.

The angular distribution of the recoil protons in neutron-proton scattering at 90 Mev has been measured for angles between 5° and 65° from the direction of the neutron beam. The neutrons were produced by stripping 190 Mev deuterons in a $\frac{1}{2}$ inch Be target in the 184" F.M. cyclotron. The neutrons were collimated by a two-inch hole through 8 feet of concrete.

Thin paraffin scatters of known hydrogen and carbon content were used; the number of protons arising from neutron-carbon and neutron-air reactions was determined by using pure carbon scatters and by making blank runs. The scatters were placed in the beam outside of the concrete shielding at a point approximately 52 feet from the cyclotron target.

Results are plotted, transposed into the center of mass system. Relative proton intensity per unit solid angle is plotted against $\cos\theta$, where θ is the scattering angle in this system. The proton peak in the forward direction is expected on the basis of exchange force theory. The apparent symmetry about 90° would indicate that there are equal amounts of exchange and non-exchanging scattering.

The errors indicated are twice the probable errors calculated on the basis of the counting statistics. The additional error is a somewhat arbitrary estimate of the

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MDDC - 1580 Proton Angular Distribution for 90 Mev Neutron-Proton Scattering, by J. Hadley, C. E. Leith, and H. F. York. 4 p. (UCRL-5) (Cont'd from page 49)

possible size of systematic experimental errors.

A detailed report of this work will be made later after more data have been taken, and the sources of experimental error more thoroughly investigated.

*MDDC - 1581 Spectrographic Determination of Trace Materials in Uranium Salts and in Magnesium, Dolomite, and Lime, by G. R. Harrison and R. Kent III. 33p.

To be included in the NNES(MPTS).

The main purpose of the project summarized in this report was to make quantitative analyses, in many thousands of samples of uranium metal, uranium oxides of various types, magnesium, lime, and dolomite, for any or all of forty metallic constituents, including the rare earths.

Special diffraction grating spectrographs of high dispersion were adapted to analytical use, and when used in conjunction with an improved carrier distillation method involving addition of silver chloride or gallium oxide to the sample being analyzed, these made possible precise determinations of amounts which with some elements could be as low as five parts per hundred million.

Most of the developmental work involved preparation of standard samples of suitable form, and the methods of making these, and of burning samples so that the standards would be comparable with them, are detailed in the report.

Tables are given of the wavelengths of the spectrum lines used, and of the sensitivities attained with each element in the various types of samples in which it was determined.

MDDC - 1582 Disintegration of Be^8, by A. Hemmendinger. 3 p. (LADC-466)

For publication as a Letter to the Editor of the Physical Review.

Various investigators have concluded that the nucleus Be^8 disintegrates into two alpha particles. The present experiment is a more precise measurement of the disintegration energy than has been reported to date.

A proportional counter of 5 cm inside diameter and 10.5 cm active length, with a wire of 0.25 mm diameter, and a copper liner on which was evaporated a thin layer of beryllium. The beryllium covered two-thirds of the cylindrical surface; a patch of one-third of the total area bounded by elements of the cylinder was left bare. The counter filling was helium; the pressure was adjusted so that the observed particles were stopped in the counter and the counter voltage was adjusted accordingly. A strong monoenergetic gamma ray source was placed near the beryllium patch and the pulse distribution in the counter was observed with a 10 channel pulse discriminator. To test whether the measured pulses were heavy particles or gamma pile-ups a similar count was made with the source near the center of the bare patch. The difference of the two counting rates was used in each measurement.

The Be^9 nucleus photo disintegrates into Be^8 and a neutron, which particles move in opposite directions. The Be^8 then disintegrates into two alpha particles; these obviously have opposite directions in the center of gravity system, but in the laboratory system they may have many orientations with respect to the direction of Be^8 recoil. After measurement of a pulse distribution in this manner the counter was placed in the beam of Li(p,n) neutrons from an electrostatic generator, and the pulse distribution of He^4 recoils in the counter was observed.

The best data were obtained using a gamma source of 0.5 curies of mesothorium, which has a 2.62 Mev gamma ray. The results are shown. Taking the value 1.68 Mev for the $Be^9(n,\gamma)$ threshold, 116 $\pm$ 10 kev for the disintegration energy of Be^8 was obtained.

Similar measurements were attempted using Sb^{123} (1.70 Mev gamma ray). The source strength was about 0.1 curie. Here the pulses sought for were much smaller and the gamma effects all but masked them. The results have much greater errors than, but are in essential agreement with, the MsTh measurement.

*MDDC - 1583 Photographs Showing Use of Health Physics Instruments, by G. W. Morgan. 31 p.

To be used in connection with a paper on protective measures in handling radioactive materials to be given at the Alabama Polytechnical Institute.

30 photographs titled as follows have been released: counting a smear; monitoring hands; electrostatic precipitator; illustration of the use of mirrors for work over lead barriers; surveying a beta emitter; beta, gamma audio-detector; (cutie pie), survey of shielded material; (cutie pie), monitoring a chemical operation; trays, containers, and shielding; steel sink; (zeus meter), surveying floor; monitoring a garment; remote control faucets; (GM input scaler), surveying a table top; monitoring shoes; taking a smear.

MDDC - 1584 Radiocarbon of High Specific Activity, by L. D. Norris and A. H. Snell. 2 p.

For publication as a Letter to the Editor of the Physical Review.

The following paper is complete.

As has been described briefly elsewhere (MDDC-726) the first 225 millicuries of Carbon 14 to be produced and distributed under the isotope program of the Atomic Energy Commission were made in an apparatus which circulated saturated ammonium nitrate solution through an irradiation tube in the Clinton nuclear reactor. The major portion of the Carbon 14 was found to be converted to $C^{14}O_2$, which was carried out of the ammonium nitrate solution by the gases resulting from radioactive decomposition of the solution itself. The gas stream was passed through bubblers containing saturated barium hydroxide, and the $C^{14}O_2$ thereby precipitated as $BaC^{14}O_3$. However, at the time the apparatus was installed, it was also expected that some Carbon 14 would be converted to $C^{14}O$, and that if this were the case the isotopic enrichment might be considerable inasmuch as there would be little possibility of dilution by natural carbon from the air. Therefore, the exhaust gas from the first barium hydroxide bubblers was passed over an oxidizing agent (hot CuO), and then led through a second series of barium hydroxide bubblers.

After several long periods of operation, very little $BaC^{14}O_3$ precipitate seemed to be present in the second series of bubblers, and it was therefore assumed that negligible evolution of $C^{14}O$ occurred. But recently these bubblers were cleaned thoroughly, all the solid material clinging to the sides of the bubblers and to the walls of the bubbler stems was scraped off. This solid material, when examined for activity, was found to contain large quantities of C^{14}. As a result, there are now two samples, each

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MDDC - 1584 Radiocarbon of High Specific Activity, by L. D. Norris and A. H. Snell. 2 p.
(Cont'd from page 52)

weighing approximately 250 mgs, which have specific activities corresponding to an isotopic concentration of 27% in the one case, and 19% in the other. These samples, which are nominally $BaC^{14}O_3$, in all likelihood contain certain solid impurities (i.e., silica, barium hydroxide), and thus the isotopic concentrations may in fact be somewhat higher than indicated by specific activity measurements.

Since the ammonium nitrate solution factory has been out of operation for some months, no more of this material can be expected from that source. The samples at hand, however, are sufficient to permit work on the spin determination, the beta spectrum, the (p,n) threshold, ahd other interesting problems.

MDDC - 1585 Uranium Hydride I. Preparation, Composition, and Physical Properties, by F. H. Spedding, et al. 29 p.

For publication in the Journal of the American Chemical Society.

The methods of preparation and formation of uranium hydride and deuteride are given. The formula of the compound is discussed and its physical chemical properties are investigated. These included its thermal decomposition, physical state, density, electrical conductivity, dissociation pressure-composition isotherms, pressure-temperature relationships, heat of formation, kinetics of formation, and hydrogen-deuterium separation studies. Finally, the classification of uranium hydride with respect to other hydrides is briefly discussed.

The evidence concerning uranium hydride presented in the paper, and the X-ray diffraction data, indicate that this substance falls into a newly recognized class. This compound is characterized by a continuous, valence-type of bonding, with each hydrogen atom bridging between two metal atoms. The theory also postulates one electron pair for the two bonds (a resonating system of electron-deficient "half-bonds"). The continuous structure accounts for the metallic properties, such as electrical conductivity and the proper spacing of the uranium atoms in the lattice.

MDDC - 1586 Uranium Hydride III. Dispersions in Mercury, by J. C. Warf, A. S. Newton, T. A. Butler, and F. H. Spedding. 11 p.

For publication in the Journal of the American Chemical Society.

The formation of dispersed systems of uranium hydride and mercury is described. The systems are termed amalgams, although the evidence disclosed that the preparations are not true solutions or amalgams, but suspensions. The consistency of the amalgams as a function of concentration, the behavior of radioxenon in uranium hydride upon amalgamation, the exchange of hydrogen with the deuterium of uranium deuteride amalgams and vice versa, the chemical properties of the hydride amalgams, and the formation of related systems are discussed.

MDDC - 1587 Excretion of Radium from the Mouse, by J. Weikel and E. Lorenz. 15 p. (ANL-HDY-366)

For publication in the Journal of the National Cancer Institute.

Excretion of radium following intraperitoneal injection was studied in three groups of strain C3H mice. Two groups were given British Anti-Lewisite as a possible means of increasing the elimination rate. In addition the radium content of a few organs of selected mice of the first group was obtained.

An average 19 per cent of the injected radium remained in the mouse at death. The average elimination rate in the chronic stage agrees well with that found by other observers.

The radium was found to concentrate in the bone immediately. It was not eliminated from the bone rapidly as it was from mostly the soft tissues, notably the spleen. Moreover, the lungs contained very little radium, whereas in the experiments of Evans et al, the lungs were the richest soft tissue.

BAL had no effect on the rate of elimination.

MDDC - 1588 The Intermediate Uranium Fluoride Compounds (α-UF_5, β-UF_5, U_2F_9, and U_4F_{17}), by P. Agron, A. Grenall, R. Kunin, and S. Weller, 19 p., n. d., decl. 1/16/48.

For publication in the Journal of the American Chemical Society.

The occurrence of two allotropic forms of the pentafluoride has been established by means of x-ray diffraction and chemical analysis. A brief survey of the conditions of preparation of α-UF_5 and β-UF_5 is given.

The black uranium fluoride originally designated as "black UF_4" has been identified as U_2F_9 by means of chemical analysis and x-ray measurements. A brief discussion of the conditions of preparation and the properties of this compound is presented. According to the nomenclature of the International Union of Chemistry, this compound should be called diuranium enneafluoride.

A new uranium fluoride compound, of composition U_4F_{17}, has been established by means of chemical and x-ray analysis. A discussion of the conditions of preparation is presented. The x-ray diffraction pattern of U_4F_{17} is compared with that of green monoclinic UF_4.

MDDC - 1589 Phosphorus Turnover and Photosynthesis, by S. Aronoff and M. Calvin, 13 p., November 20, 1947 (UCRL-10)

For publication in Plant Physiology.

The participation of phosphorus in biological oxidation-reduction reactions of the type found in glycolysis ADP + PO_4H^- + 3-phosphoglyceraldehyde + DPN^+ = 3-phosphoglycerate$^-$ + $2H^+$ + DPNH + ATP has suggested theories in which similar reactions are proposed for photosynthesis (Lipmann, Ruben, Emerson, Stauffer, and Umbreit). In these theories the reducing power of photosynthesis is utilized not only for reduction of carbon dioxide but also, by means of coupled oxidations, for the generation of high-energy phosphate bonds, or in the last reference directly for the generation of high-energy phosphate. Since in these theories acyl phosphate is formed from inorganic phosphate, they are amenable to proof without isolation of particular intermediates, by means of radioactive phosphorus. It would be expected that the rate of conversion of inorganic phosphate to organic phosphate would be greater in light than in the dark. This possibility was investigated under a variety of conditions, and the theories could not be substantiated.

MDDC - 1590 The Assessment of Gamma Radiation Dosage by Means of Radioisotopes in Mockups, by J. G. Hoffman, 5 p., n. d., decl. 12/30/47 (LADC - 476)

For publication in Science.

The reciprocal relationship between a radiation source and absorber makes possible the measurement of whole body dosage by means of gamma emitting radioisotopes. The application is illustrated for the case of a human being standing on an infinite plane of radiating material. The use of Na^{24} in evaluating slow neutron doses is indicated. It affords an empirical method for (a) determining slow neutron flux in the body, and (b) measuring the self-dosage due to H^{1} capture gammas.

* MDDC - 1591 Writing of Reports and Memoranda, edited by D. R. Inglis, 7 p., n. d., decl. 12/30/47 (LADC - 480).

Disposition as required for use in research, development, or manufacturing work.

Advice on writing reports and memoranda is given under the following headings: need for reports, categories, memoranda, preparation of graphs and drawings, symbols, preparation of manuscripts, equations in theoretical papers, and listing of workers and authors.

MDDC - 1592 Ultrasonic Velocity in Some Liquid Fluorocarbons, by R. T. Lagemann, W. E . Woolf, J. S . Evans, and N. Underwood, 12 p., n.d., decl. 1/9/48 (K-66).

For publication in the Journal of Chemical Physics.

The ultrasonic velocity over the temperature range 20° to 70°C has been measured for four chlorotrifluoroethylene polymers, three samples of fluorolube oil, three heavily fluorinated cyclohexane derivatives, and hexadecafluoroheptane. Remarkably low values of the velocity were found, all being less than 935 m/sec in the temperature range studies, and that of hexadecafluoroheptane being only 444 m/sec at 60°C. For each liquid the velocities were found to vary linearly with temperature. The molecular sound velocity for the chlorotrifluoroethylene polymers was found to vary linearly with the molecular weight and with the molecular refraction in agreement with earlier work on ethylene glycol polymers.

The report includes a table on certain physical properties of some fluorocarbons and one on ultrasonic velocities in some fluorocarbons.

MDDC - 1593 Ionization Chamber Studies of Energy Transfer from 100 Mev Neutrons to Light Nuclei, by R. Loevinger, 85 p., October 21, 1947. (BP-139)

Disposition as required for use in research, development, or manufacturing work, and for possible publication in a technical journal.

If an ionization chamber consisting of a small cavity in solid material is placed in a field of non-ionizing radiation, then, under certain conditions, there exists the following relationship:

> Energy dissipated per unit volume of wall material = average energy per ion pair in the gas X relative stopping power for the ionizing secondaries X number of ion pairs formed per unit volume in the gas.

This relationship has been known for many years. In order to apply it to the 100 Mev neutron beam, it has been formulated in a sufficiently general fashion so that it can be used without detailed knowledge of the nature of the interaction between the neutrons and the nuclei.

In order to determine the conditions under which the stated relationship is valid for the 100 Mev neutron beam, the ionization was studied as a function of size of cavity, thickness of wall material, and composition of wall material. The effects of neutron attenuation and backscatter were determined. The result was a determination of the relative contribution of hydrogen, carbon, and oxygen nuclei to the total energy dissipation in hydrogenous solids. The measurements also yielded a determination of the absolute value of the energy flux of the neutron beam, which checked closely with a simultaneous determination made by an entirely different method.

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MDDC - 1593 Ionization Chamber Studies of Energy Transfer from 100 Mev Neutrons to Light Nuclei, by R. Loevinger, 85 p., October 21, 1947. (BP - 139) (Cont'd from page 59)

The results can be used to calculate the energy dosage to tissue of known composition from a monitored exposure to the neutron beam, with an accuracy of about 10%. The results will also be useful in the future in developing the theory of the interaction between 100 Mev neutrons and the light nuclei, particularly with regard to star formation.

*MDDC - 1594 Stars in Photographic Emulsions, Part I. Experimental, by E. Gardner and V. Peterson, 12 p., December 1, 1947. (UCRL-18)

For oral presentation before a meeting of the American Physical Society held in Los Angeles, January 2 and 3, 1948.

Abstract of this report previously listed as MDDC-1410.

Photographic plates were bombarded in the 184" Berkeley cyclotron for the purpose of studying stars initiated by deuterons and alpha particles. The number of prongs (i.e., the number of charged particle tracks making up the star) were tabulated for 1200 stars initiated by deuterons and 100 stars initiated by alpha particles. Protons of energy more than about 10 Mev do not make recognizable tracks in the emulsions which were used, so the results will not include prongs due to high energy protons. For stars initiated by deuterons more 3-prong stars were found than any other kind. This is true for all incident deuteron energies from 40 Mev to 190 Mev. Preliminary results indicate that for stars initiated by alpha particles the average number of prongs is slightly higher. For deuteron-initiated stars there are about three times as many prongs in the direction of the beam as in the backward direction. The cross section for formation of stars by alpha particles is being measured by counting sections of tracks made by alpha particles and the stars originating on these tracks.

MDDC - 1595 The Relative Energies of the Gamma Radiations from Co^{60} and Zn^{65}, by E. N. Jensen, L. J. Laslett, and W. W. Pratt, 3 p., n. d., decl. 1/6/48.

For publication in Physical Review.

The gamma ray spectra of Co^{60} and Zn^{65} were studied with a thin-lens magnetic spectrometer, using the photoelectrons ejected from a thin lead foil. Measurements obtained indicated the energy of the radiation from Zn^{65} (1.11 Mev) to be somewhat below that for the lower energy Co^{60} line (1.16 Mev).

To effect a direct comparison of these gamma ray energies, a source with both activities was placed in the spectrometer and the composite spectrum obtained. The results of this test confirmed the conclusion that the zinc radiation has the lower energy.

It is felt that such a comparison is of interest, since the previously published data have not indicated this relationship clearly and since the cobalt radiations have been proposed as suitable standards for gamma ray energy measurements.

MDDC - 1596 The Comparative Metabolism and Distribution of Carrier-Free Radioarsenic (As^{74}), by H. Lanz, Jr. and J. G. Hamilton, 19 p., n. d., decl. 1/8/48.

For publication in the Journal of Pharmacology.

Rats, cats, dogs, guinea pigs, rabbits, mice and chicks were injected intramuscularly with carrier-free radioarsenic, as arsenate, and the distribution in various organs as a function of time was studied. In vivo, rat blood concentrated the arsenate to a remarkable extent, approximately 50% of the dose finding its way into the blood stream 48 hours after administration of the arsenic. The site of concentration in the blood appeared to be the hemoglobin. No other species approached the rat closer than a factor of ten in this respect, the cat being the only species which resembled the rat to any extent. In vitro, it was found possible to introduce the radioarsenate into the red cells of rabbits and humans, as well as rats. In vivo this was only possible with the rat and to a much smaller degree with the cat. Muscle and skeleton were the chief points of concentration in all animals except the rat. Even there, the concentrations were of the order of 1-2% at 48 hours, indicating rapid excretion. The livers of the rat, cat, rabbit, and guinea pig also showed approximately a 1% uptake at 48 hours, while mouse and chick livers only yielded slightly more than traces.

MDDC - 1597 Progress Report for August 1947, Medical and Health Physics Section, Part A-Cobalt Distribution, by P. P. Weymouth, L. R. Wasserman, N. Berlin, and R. Rosenthal, 5 p., August 1947. (BP-127)

For publication in a biological journal.

The study of cobalt distribution in animals was undertaken as preliminary to two experimental lines: 1) a study of cobalt polycythemia; 2) a study of distribution of cobalt labeled dyestuffs particularly in relation to tumor tissue.

The cobalt, produced by the reaction $Co^{59}(N,\gamma)Co^{60}$, was administered in the form of cobaltous chloride. Normal and myeloid leukemic C 57 mice received by intravenous injection 13 μg Co^{60}, 13.5×10^3 d/s. From each group 3 mice were perfused at each time period indicated and samples taken for analysis.

The tissues were wet ashed in HNO_3, $HClO_4$, and H_2SO_4; and all HNO_3 and $HClO_4$ removed by bringing the ash to fuming (SO_3). The ash was partially neutralized with NH_4OH and transferred to the plating cell with 20 ml 2% $(NH_4)_2SO_4$ in NH_4OH. About 10 mg cobaltous sulfate was added as carrier and the sample plated on copper for 2 hours at 200 m amps. Because of the large amount of ash in bone, intestine and excreta, these samples were treated as follows. Carrier cobalt was added and the solution was precipitated with NH_4OH. Since some of the Co was carried down with the precipitate, it was necessary to redissolve in concentrated HCl and re-precipitate. This was done 4 times or until the activity of the residual precipitate was negligible. The supernatants were combined, transferred to the plating cell, $(NH_4)_2SO_4$ was added and the material plated as before. The plates were counted using a thin-mica-window counter tube.

One table shows the amount of cobalt, as per cent of injected, retained by the body at the experimental time intervals.

Two tables show concentration of radioactive Co in d/s/gm in the tissues tested of normal and leukemic mice, respectively. The average standard error for 65 triplicate determinations is 20.2%. At 6 hours, liver in both normal and leukemic mice shows the highest concentration, the remainder of the tissues with the exception of normal blood and leukemic muscle and normal and leukemic brain show concentrations 1/2 to 1/5 those of liver. Brain is consistently low in both groups showing a concentration about 1/30 that of liver. Comparing normals and leukemics at 6 hours, skin, blood, lymph nodes, and thymus have a higher concentration of cobalt in leukemics, and intestine, stomach, bone, muscle, lung, and genitalia, a lower concentration. The higher concentration of cobalt in the blood of leukemic mice is almost entirely due to higher plasma concentration, since the washed cells in both normals and leukemics retain about the same amount. The remainder of the tissues show approximately the same concentrations in both normal and leukemic mice. The decrease in cobalt concentration is very rapid in all tissues after the first day, although liver, spleen, kidney, and pancreas of leukemic mice appear to lose cobalt less rapidly than these tissues of normal mice during the first three days.

*MDDC - 1598 Oscilloscope Camera Self Supporting (consisting of 9 drawings), Los Alamos, 9 p., April 20, 1945 (LADC-471)

Disposition as required for use in research, development, or manufacturing work.

This document consists of nine engineering drawings of a self-supporting oscilloscope camera which employs either a Zeiss Sonnar f 1.5, 50 millimeter lens or a Kodak Ektar f 2.0, 45 millimeter lens, an Ilex shutter, and a Graphic Camera 4" x 5" back as film holder. Brief instructions for using the equipment and the types of films or plates employed are also included.

MDDC - 1599 The Velocity Distribution of the Neutrons Emitted from a Slow Neutron Source, by C. P. Baker, B. D. McDaniel and R. F. Bacher, 13 p., April 6, 1942.

Publication in a technical journal.

In previous work (Phys. Rev. 69 443) the conclusion was reached that the energy distribution of cadmium stopped neutrons ("C" group) from commonly used sources was not Maxwellian.

It was suggested that it would be desirable to find the energy distribution of this group directly to see in what manner it departed from a Maxwellian distribution and to provide a further check.

The direct measurement of this distribution by the time of flight method is complicated by the uncertainty in the time of emission of thermal neutrons from the source.

The uncertainty in time of emission makes the measured time of flight uncertain and at the distances normally used between source and detector, it is by no means negligible.

It was felt that the source detector distance should be increased sufficiently so that the time spent in travel between source and detector would be large compared with any uncertainty in time of emission. The principal difficulty with this method was thought to be in the available intensities at large distances. It was found that by sacrificing a certain amount of resolution this latter method could be used and was, therefore, adopted.

The experiments were carried out at a distance of 7.80 meters between source and detector. The collimation normally used was thought to be insufficient and a Cd pipe 120 cm. long and 6 cm. in

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MDDC - 1599 The Velocity Distribution of the Neutrons Emitted from a Slow Neutron Source, by C. P. Baker, B. D. McDaniel and R. F. Bacher, 13 p., April 6, 1942. (Cont'd from page 63)

diameter and 9 gm./cm^2 thick was used in addition to the B_4C and Cd collimators used in front of the detector. Neutrons were produced in 400 μ sec. bursts, and those arriving at the detector in various time intervals of 400 μ sec. duration were recorded.

Two sources were measured; first, a copper water tank which was filled with distilled water and, second a paraffin block.

It is shown that the 7.80 meter data differs markedly from a Maxwell distribution showing more neutrons at higher energy and relatively fewer and fewer as the energy decreases below the maximum.

Results are tabulated and curves plotted.

MDDC - 1600 The Preparation of Carrier-Free I^{131}, by D. S. Ballantine and W. E. Cohn, 6 p., May 15, 1947. (CL-WEC-11).

Disposition as required.

Besides its general usefulness in chemical research, the 8-day I^{131} radioisotope has been used for many years as a tracer in biological investigations of thyroid function. The quantities of iodine required by the thyroid are minute and previous work has shown that the uptake or turnover of radioiodine by the thyroid is dependent upon the total mass of the element administered with the tracer. A true tracer experiment therefore requires iodine with a high specific radioactivity. For experiments where deposition in the thyroid of a "therapeutic" amount of radioiodine is required, the specific activity must be still greater. Carrier-free radioiodine is the material of choice.

I^{131} is produced in two ways: (1) the n, γ (or d,p) reaction on Te^{130} to give Te^{131} which decays with a 30-hour period to I^{131}; (2) uranium fission. Both processes yield carrier-free material provided the separation of the radioiodine from the Te in the first case and from a nitric acid condensate of off-gases from the uranium solution process in the second can be accomplished without the addition of carrier.

This paper describes the methods which have been developed for the isolation of pure, "carrier-free" iodine.

*MDDC - 1601 **Programs in Toxicity and Metabolism of Commonly Used Isotopes, by A. M. Brues, 1 p., March 5, 1947. (ANL-AMB-33).**

Disposition as required for use in research, development and manufacturing work.

The entire text of the report is reproduced here.

Upon attending several isotope meetings, it was discovered that there is a great deal of interest on the part of scientists receiving isotopes from the Atomic Energy Commission to know more about the possible hazards involved in their use. This is especially true of P^{32} and C^{14}. The purpose of this is to outline what is being undertaken in this regard.

P^{32}. Since little difference is found between the chronic effects of radium and strontium, a comparable toxicity experiment as described in a declassified monograph was set up using P^{32}. This is tremendously important since many patients are receiving relatively large doses of P^{32} and not all of them may be suffering from a malignant disease.

C^{14}. Following the brief note published by Drs. Bloom, Curtis and McLean in Science (Feb., 1947), Drs. Bloom and Mc Lean, in conjunction with Dr. Morris, are preparing an experiment along the same lines from which more quantitative information can be obtained on retention of C^{14} by animals given the isotope. Dr. Morris is also in process of setting up an experiment to determine the overall carbon metabolism of animals breathing active CO_2 vapor. It is also planned to investigate the metabolism and toxicity of organic molecules containing C^{14}.

An experiment is being set up to determine retention by growing tissue.

MDDC - 1602 **Electric Time-Switch for Closing Circuits at Accurately Regular Intervals, by J. A. Crawford and A. H. Jaffey, 11 p., May 26, 1947. (CP-3799).**

Disposition as required for use in research, development, and manufacturing work. This also declassifies the electric time-switch.

The purpose of the time-switch described is to make an electrical contact (for a few seconds) at equal intervals of time. This contact can serve to control a relay, in turn controlling any device which is designed to operate at equal time intervals.

The essential features of the time-switch are:

1. The intervals of time between successive "make", are very accurate and reproducible to within considerably less than 0.01 minutes.
2. The duration of contact is about 2.2 seconds.
3. The period of the contact-cycle can be varied. It can be made: 1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30 or 60 minutes.
4. The current and voltage ratings of the time-switch are 0.5 amp, 30 volts.

The details of the mechanical construction are shown in two drawings. A circuit diagram of the switch, a wiring diagram including the switches, and a sketch of the two knobs controlling the switches are also included in the report.

*MDDC - 1603 Heats of Reaction of the Aqueous Uranium Oxidation-Reduction Couples, by B. J. Fontana, 18 p., April 1, 1947.

For use in lectures and seminars.

The heats of the $U^{+3} \rightarrow U^{+4}$ and $U^{+3} \rightarrow UO_2^{+2}$ couples in 0.5 M $HClO_4$ have been determined through the reaction of U^{+3} with Fe^{+3} giving $\Delta H_{298} = +9.3 \pm 0.3$ and -23.7 ± 0.4 kcal per mole, respectively. Re-examination of the aqueous uranium ion oxidation-reduction potentials using the above heats (and that previously determined for the $U^{+4} - UO_2^{+2}$ couples, $\Delta H_{298} = +32.94 \pm 0.06$ kcal/mole) leaves no doubt that the correct values are + 0.63 volts for $U^{+3} \rightarrow U^{+4}$ (1 M HCl) and − 0.33 volts for $U^{+4} \rightarrow UO_2^{+2}$ (0.5 M HCl). Values of the ionic entropies thus calculated, based on $S(UO_2^{+2}) = -17$ e.u., are $S(U^{+3}) = -32$ e.u. and $S(U^{+4}) = -79$ e.u.

The heats of solution of UCl_3 (S) and UCl_4 (S) in 0.5 M $HClO_4$ have been measured, yielding $\Delta H_{298} = -28.9 \pm 0.4$ and -55.60 ± 0.06 kcal. per mole, respectively. Combination of the latter results with the heats of formation of UCl_3 (S) and UCl_4 (S) obtained from the literature allows estimates of the various oxidation-reduction heats to be made. The values thus obtained are consistent with those directly determined to within about ±1 kcal. per mole, subject, however, to the calculation of the new value $\Delta H_{298} = -113.1 \pm 0.7$ kcal per mole for the U(S) $\rightarrow UO_2^{+2}$ couple.

MDDC - 1604 The Evaporation of Gallium, by S. K. Haynes, 4 p., March 6, 1947.

Oral presentation before a meeting of the American Physical Society held in Salisbury, N. C. in April, 1947.

MDDC - 693 is an abstract of this report.

The thin β-ray source was made by evaporating gallium onto a thin sheet of polystyrene. Since gallium was not among the metals for which evaporation procedures were given by Olsen, Smith and Crittenden an investigation was made to find the best procedure. A modification of the procedure for aluminum was finally used. The gallium was warmed just above its melting point and "buttered" onto a cooler clean open helix of 30 mil tungsten wire, drop by drop, until the tungsten was almost covered. When the tungsten was flashed to a dull red in vacuum, a fraction of the gallium reacted with it, while the remainder dropped out. The tungsten retained all the gallium ready for the final evaporation after a second "buttering" and flashing. Several other methods were tried with less success, including a close wound conical helix of tungsten and a tantalum crucible heated by a filament.

MDDC - 1605 The Preparation of Thin U_3O_8 Films, by M. Kahn, 25 p., April 22, 1943.

For publication in the Physical Review, or Review of Scientific Instruments.

In the course of different investigations on the radioactive properties of uranium it was necessary to prepare a thin uniform film of U_3O_8 on a platinum disk, so that the alpha-particles emitted could have their full range outside of the U layer.

Two different methods of forming thin films of U_3O_8 by electro deposition and ignition were investigated.

The method involving the fluoride ion (electrolysis of a $UO_2(NO_3)_2$ solution that contains a small amount of NaF) is considered the better method. The films are very satisfactory for alpha counting and the UF_4 deposition is quantitative. The method is very easy to carry out and requires little time.

The method involving KOH – K_2CO_3 mixtures shows very good possibilities.

The deciding factor is the K_2CO_3 concentration which could be easily determined by experimentation.

MDDC - 1606 Metabolism of Phosphorus in Paramecium Aurelia by E. L. Powers, Jr., 10 p., May 20, 1947.

Oral presentation before a symposium on Nucleic Acids at Cold Spring Harbor on June 11, 1947.

Observations on the course of metabolism of phosphorus in normal dividing Paramecium aurelia have progressed to the point where preliminary results can be reported. Although no definite conclusions are possible at this time, several are indicated, and the investigations necessary to arrive at others are now recognized.

The general method used to follow the phosphorus atom during the normal metabolic processes was as follows: all the systems containing phosphorus were saturated with the radioactive isotope P^{32}; the source of P^{32} for the animals was withdrawn; and the distribution of P^{32} within the animals was sought at intervals after withdrawal. This method was chosen after it had been demonstrated in preliminary experiments that the rate of absorption of P^{32} by the organisms from solution is too slow in subtoxic concentrations of P^{32} and its carrier to allow convenient time measurements.

Results are tabulated and plotted.

MDDC - 1607 An Investigation of the Delayed Neutron Decay Curves Resulting from Uranium and Plutonium Fission, by C. Redman and D. Saxon, 16 p., November 4, 1944. (Physical Review Vol. 72, p. 570-575, October 1, 1947)

Employing the graphite pile at Argonne samples of Pu^{239} and enriched U^{235} were irradiated, and the decay curves resulting from delayed neutrons emitted in the fission process were analyzed. Appropriate intensities and lengths of irradiation were used to best resolve the various delayed neutron periods. To obtain the shortest periods a mechanism was built that would transfer the sample from a pile to a BF_3 proportional counter geometry in less than one second. The decay curves were recorded on a magnetic wire recorder. Analysis of the decay curves, 18 successful runs on Pu^{239} and 37 for U^{235}, show that they are best fitted by the formulae:

$$A_t = C_{Pu}(1.2e^{-0.660t} + 1.1e^{-0.154t} + 1.0e^{-0.0310t} + 0.11e^{-0.0126t}) \text{ for } Pu^{239},$$

$$A_t = C_U(1.65e^{-0.613t} + 1.36e^{-0.156t} + 1.00e^{-0.0308t} + 0.15e^{-0.0126t}) \text{ for } U^{235},$$

when all the periods are irradiated to saturation.

Within the limits of experimental error, the half-lives for Pu^{239} and U^{235} are identical, namely: (55.0 ± 0.4) sec., (22.5 ± 0.3) sec., (4.45 ± 0.15) sec., and (1.10 ± 0.06) sec.

The error limits given were determined from the internal consistency of the various values of the periods, not from the statistical fluctuations in the counting procedure.

The change in the yield of the 55.0-sec. period relative to that of the 22.45-sec. period, in going from U^{235} to Pu^{239}, is of the proper sign but small in magnitude as compared to the change predicted from the fission yields for the known mass numbers of these delayed-neutron emitters. A comparison of the relative number of delayed neutrons per fission gives the ratio of the number from Pu^{239} to the number from U^{235} as 0.5.

MDDC - 1608 The Structure of the Carbides, Nitrides and Oxides of Uranium by R. E. Rundle, N. C. Baenziger, A. S. Wilson, and R. A. McDonald, 21 p., n.d., decl. 3/5/47.

For publication in the Journal of the American Chemical Society.

The systems uranium-carbon, uranium-nitrogen and uranium-oxygen have been given thorough X-ray study in the course of work carried out for the Metallurgical Project. In this paper this work is summarized rather briefly, giving pertinent structural information and necessary details concerning the methods used in carrying out the work.

1. Uranium monocarbide is face centered cubic, a = 4.951 Å, and has the sodium chloride-type structure. Uranium dicarbide is body-centered tetragonal, $\underline{a}$ = 3.517 Å, $\underline{c}$ = 5.987 Å, and has the calcium carbide structure. Carbon is soluble in the dicarbide at high temperatures, and the dicarbide decomposes into the monocarbide and carbon at intermediate temperatures. Uranium sesqui-carbide probably exists at temperatures above 2000 . It does not exist at room temperature.

2. Uranium mononitride is face-centered cubic, $\underline{a}$ = 4.880 Å, and has the sodium chloride-type structure. Uranium sesquinitride is body centered cubic, $\underline{a}$ = 10.678 Å, and has the manganese sesquioxide structure. The uranium sesquinitride structure gradually changes toward the ideal dinitride structure in a one phase region extending to the composition $UN_{1.75}$. High pressure is needed to form the dinitride which is face-centered cubic, $\underline{a}$ = 5.31 Å, and has the fluorite structure.

3. Uranium monoxide is face-centered cubic, $\underline{a}$ = 4.92 Å, and has the sodium chloride-type structure. It is very difficult to prepare free from carbon or nitrogen. Uranium dioxide has the fluorite structure, $\underline{a}$ = 5.4381 Å. Oxygen is soluble in the fluorite structure up to approximately the composition $UO_{2.25}$ at which point the lattice constant is $\underline{a}$ = 5.4297 Å. U_2O_5 is orthorhombic, $\underline{a}$ = 6.72 Å, $\underline{b}$ = 31.8 Å, $\underline{c}$ = 8.27 A. The structure is related to those of U_3O_8 and UO_3. A one phase region exists from U_2O_5 to UO_3 in which the various structures continuously transform from one to another.

MDDC - 1609 The Transuranium Elements, by G. T. Seaborg and E. Segre, 10 p., n. d., decl. 3/24/47. (BC-33) (Nature Vol. 159, p. 863-865, June 28, 1947.

A discussion is given of the formation, discovery, and identification of Pu, Np, Am, and Cm.

MDDC - 1610 The Bromine Displacement Method for the Determination of Fluorine in Gas Mixtures by E. Staple, J. G. Schaffner and E. Wiggin, 15 p., March 31, 1946. (A-3631)

For publication in the Journal of the American Chemical Society.

This report is concerned with one of several methods for the analysis of gas mixtures to determine fluorine content. The method consists of liberation of bromine from a bromide by fluorine and the subsequent measurement of light absorption by the bromine. Its advantages lie in the fact that the results obtained are within the range of desired accuracy and reproducibility, and the method is adaptable to an inexpensive, portable unit giving continuous results. The apparatus may be operated by personnel of limited training to give accurate results.

The report includes a photograph of the photo-bromine apparatus, a flow diagram of the system, a drawing of the optical system, and a drawing of the pressure regulator.

*MDDC - 1611 Firing Unit for X-Ray Generator (Circuit drawings 527, 528, 529, and Y-+310C-1A), by E. W. Titterton, 4 p., February 14, 1945. (LADC-362).

Disposition as required for use in research, development, and manufacturing work.

Four circuit diagrams are labeled as follows: Firing unit for X-ray generator, delayable auxiliary driver for X-ray generator, proposed pulsed X-ray generator, and delayed trigger firing unit.

*MDDC - 1612 A General Basis for the Resonance Formula by E. P. Wigner and L. Eisenbud, 1 p., n. d., decl. 4/2/47.

Published in Physical Review p. 155, July 15, 1947.

Oral presentation before a meeting of the American Physical Society. The complete text is reproduced herewith.

The solution of the Schrodinger equation, $H\phi = E\phi$ within a region of configuration space bounded by a surface S, may be expressed in terms of its normal derivative, $\delta\phi/\delta n$, on S, as

$$\phi = \sum_\lambda \frac{X_\lambda}{E_\lambda - E} \int X_\lambda^* \, \delta\phi/\delta n \, \phi \, S = \sum_\lambda \frac{\gamma_\lambda X_\lambda}{E_\lambda - E} \qquad (1)$$

where X_λ is a characteristic function of the hermitean boundary value problem $HX_\lambda = E_\lambda X_\lambda$ with the boundary condition $\delta X_\lambda/\delta n$ on S Eq. (1) defines γ_λ. If the general solution of the Schrodinger equation in the region outside S is known, the relation between ϕ and $\delta\phi/\delta n$ on S given by (1) is sufficient to determine those solutions which, together with the ϕ of (1), satisfy the quantum mechanical equations everywhere. When in a limited region of energy, the series in (1) may be adequately expressed by a single term plus a constant, the resulting wave functions imply the dependence of cross section on energy which is given by the usual resonance formula for nuclear reactions.

MDDC - 1613 Negative 4 KV and Positive 6 KV High Voltage Power Supply, by W. A. Hane, 4 p., May 9, 1945. (LADC-453)

Disposition as required for use in research, development, and manufacturing work. This includes declassification of the R. F. Power Supply

Construction drawings, circuit diagrams, and parts list are given for a 10 KV-RF high voltage doubler type power supply.

MDDC - 1614 Radiation Meter Model "B", by R. Watts, 1 p., April 18, 1946. (LADC-455)

Disposition as required for use in research, development, and manufacturing work. This includes declassification of the instrument.

Circuit drawing is presented of an electrometer type ionization chamber survey meter.

MDDC - 1615 Technique for Irradiating Microorganisms with Artificially Radioactive Materials. Part II - External Radiation Sources, by E. H. Anderson, G. E. Stapleton, and A. C. Newton, 13 p., December 26, 1947.

For oral presentation before a meeting of the American Association for the Advancement of Science held in Chicago in December 1947, and for possible publication in a technical journal. This also includes declassification of the chamber for irradiating microorganisms.

Special irradiation chambers have been devised which permit the quantitative exposure of large numbers of microorganisms to high intensities of beta radiation. Adequate shielding is incorporated in the chambers to provide complete protection to the operator.

The source material used in the chambers is amorphous-red phosphorus impregnated in bakelite, according to the methods worked out by John R. Raper formerly of Clinton Laboratory. The beta ray sources, in the form of circular plaques, are activated in the Clinton pile.

Two types of irradiation chambers are described. One permits the exposure of microorganisms on an agar surface; the other allows small thicknesses of a liquid suspension to be irradiated in a uniform field of beta-rays, the intensity of which can be readily determined.

Six photographs of apparatus used are included.

*MDDC - 1616 A Modified Method for the Determination of Chromium in Uranium or Its Compounds, by C. E. Bricker and N. H. Furman, 11 p., June 19, 1943.

To be included in the NNES (MPTS).

Since a solution of uranyl sulfate has 100 per cent transmission beyond 520 mμ and the minimum of the diphenyl carbazide chromium complex is at 540 mμ, it was possible to determine chromium by this method in the presence of the uranyl ion without making any separations or extractions. The transmission curves of uranyl sulfate, of diphenyl carbazide in 0.1 per cent sulfuric acid, and of the diphenyl carbazide-chromium complex in 0.1 per cent sulfuric acid are shown.

Although the maximum amount of chromium that can be determined in 25 ml was not determined, it appears that the calibration curve may be linear only to 40 micrograms of chromium per 25 ml. Thus, if a sample contains more than 50 p. p. m. of chromium, only 5 ml aliquots should be taken for analysis.

This method for chromium is fairly rapid and gives very reproducible results. The chromium diphenyl carbazide color in the presence of the metal, etc., is not too stable but is quite satisfactory for colorimetric measurement. There is no detectable amount of fading in 15 minutes. It is best, however, to add the reagent and measure the transmittance as soon as possible. Although Although a thorough investigation of the rate of fading has not been made, it was found that after three or four hours, the solution had about 20 per cent more transmittance.

*MDDC - 1617 The Solubility of Sodium Uranyl Carbonate in Water and in Solutions of Various Salts, by W. E. Bunce, N. H. Furman, and R. J. Mundy, 14 p., May 1947

To be included in the NNES (MPTS).

1. The tricarbonate, sodium uranyl carbonate, was prepared by a slight modification of a process that was described in 1842 by Ebelman.

2. It was found that the tricarbonate was less soluble in water or in solutions of sodium carbonate or sodium bicarbonate as the temperature was increased.

3. The solubility of the tricarbonate at any temperature decreased with increasing concentrations of sodium carbonate or of sodium bicarbonate.

4. Sodium sulfate and potassium sulfate decreased the solubility of the tricarbonate in water and in solutions of sodium carbonate or sodium bicarbonate.

5. Ammonium sulfate caused an increase in the solubility of the tricarbonate over that found in water.

6. Solubilities were measured at 30°, 60°, and 90°C for the solutions that were stable at the three temperatures.

7. Equilibrium was attained very slowly either from supersaturated or unsaturated solution, with an excess of solid present.

*MDDC - 1618 The Determination of Water in Uranyl Nitrate and in Ethereal Solutions of Uranyl Nitrate, by J. A. DiPace and N. H. Furman, 9 p., April 1947.

To be included in the NNES (MPTS).

The primary purpose of this study was to find a method for the determination of water in the solvent layers that had been shaken to equilibrium with aqueous solutions of uranyl nitrate or other nitrates. The chief problem is the removal of the last molecules of water that are mostly firmly bound in the molecule of hydrated uranyl nitrate.

The Karl Fischer reagent for water has been found useful for the determination of the water of hydration of uranyl nitrate by dissolving the salt in dry methanol, adding a measured amount of the Fischer reagent, and back-titrating the excess of the Fischer reagent with a standard solution of water in methanol.

Water in ethereal solutions of uranyl nitrate may be determined with the Fischer reagent by the same type of procedure that is used for uranyl nitrate.

***MDDC - 1619** **The Use of Cupferron in Inorganic Analysis with Special Reference to the Determination of Uranium. I - Introduction. The Properties of Various Cupferrates, by N. H. Furman and W. B . Mason, 17 p., April 1946, rev. May 1947.**

To be included in the NNES (MPTS).

The work of numerous investigators who have studied the properties and the analytical applications of cupferron, phenyl nitrosohydroxylamine ammonium, following its introduction by Baudisch is summarized in this paper.

The facts upon which the use of cupferron as an analytical reagent depends have been reviewed. The great usefulness of the reagent in the analytical separation of various other elements from uranium has been pointed out.

***MDDC - 1620** **The Use of Cupferron in Inorganic Analysis with Special Reference to the Determination of Uranium. II. The Factors That Control the Extraction of Various Elements from Aqueous Solution by Cupferron Plus an Organic Solvent, by N. H. Furman and W. B. Mason, 11 p., 1946, rev. May 1947.**

To be included in the NNES (MPTS).

A theoretical formulation of the factors that enter into the extraction of cupferrates of the metals to organic solvents is given. The conclusion is reached that under the conditions which prevail in many extractions a large volume of organic phase may not be advantageous since the distribution of hydrogen cupferrate is of the order of 200 between acidic aqueous solutions and chloroform.

New experimental data on the distribution of copper, uranium (IV), and molybdenum is presented.

***MDDC - 1621** **The Use of Cupferron in Inorganic Analysis with Special Reference to the Determination of Uranium. III. The Isolation of Uranium as the Quadrivalent Cupferrate, by N. H. Furman, W. B. Mason, and J. S. Pekola, 16 p., 1946, rev. May 1947.**

To be included in the NNES (MPTS).

The precipitation of quadrivalent uranium cupferrate has been critically tested and found to be adequate provided losses during washing are avoided by adding hydroxylamine hydrochloride and by using a larger concentration of cupferron in the wash solution than has been the custom.

A procedure for the semimicro isolation of uranium by extractions with an ethereal solution of hydrogen cupferrate with repeated reduction by liquid zinc amalgam has been developed.

***MDDC - 1622** **The Interference of Nickel in the Reduction of Uranium Solutions in the Jones Reductor, by N. H. Furman and J. B. Heberling 8 p., May 1947.**

To be included in the NNES (MPTS).

Nickel interferes seriously with the reduction of uranyl solutions in the Jones reductor. The nickel that is deposited causes vigorous hydrogen evolution so that eventually the reductor will not reduce uranyl solutions quantitatively. Cobalt, manganese, zinc, calcium, magnesium, aluminum and sodium ions have no apparent action upon the reduction or the subsequent aeration to convert U(III) to U(IV). Nickel ion, if added after reduction of a uranium solution has no harmful effect upon the aeration and the titration with a standard ceric sulfate solution.

*MDDC - 1623 Uranyl Cupferrates. The Extraction of Traces of Uranium Cupferrate by Ether from Concentrated Uranyl Solutions. The Preparation of $UO_2(O(NO)NC_6H_5)_2 \cdot NH_4O(NO)NC_6H_5$, by N. H. Furman and D. R. Norton, 10 p., April 1947.

To be included in the NNES (MPTS).

It is shown that minor amounts of uranium are extracted by ether and cupferron from concentrated solutions of uranyl sulfate, containing free sulfuric acid. The ether extract upon evaporation yields the form of uranyl cupferrate that is obtained by precipitation. Chloroform extracts a negligible amount of uranium under similar conditions.

Uranyl cupferrate that is precipitated by a slight excess of cupferron from a neutral aqueous solution has a composition that may be represented by the formula: $UO_2(O(NO)NC_6H_5)_2 \cdot NH_4O(NO)NC_6H_5$.

The precipitate is practically insoluble in ether, water or 10 per cent sulfuric acid. It dissolves slightly in methanol, acetone, and ethanol as well as in neutral or acidic concentrated solutions of uranyl sulfate. The uranyl cupferrate is decomposed upon heating to approximately 200°C.

*MDDC - 1624 A Critical Study of the Turneric Procedure for the Determination of Small Quantities of Boron, by R. J. Mundy and N. H. Furman, 19 p., September 30, 1944, rev. May 1947.

To be included in the NNES (MPTS).

The turmeric procedure developed by Naftel for determination of boron has been critically investigated and found to produce an accuracy of ± 10 per cent for quantities of the order of one microgram.

The effect of varying the amount of reagents used in color development has been determined by changing the concentration of one compound at a time while all the others were held constant. The importance of adding an accurate amount of each compound is revealed.

The effect of various physical factors such as rate of evaporation, drying time and temperature, and size of dishes used for evaporation were studied. Of all the effects involved, the rate of evaporation is the most difficult to control since it is dependent upon air conditions within the laboratory that vary considerably.

The effect of numerous cations on the color development has also been investigated.

*MDDC - 1625 Electronic Classifying, Cataloging, and Counting Devices, by J. H. Parsons
2 p., n.d., decl. 12/1/47.

For oral presentation before a meeting of the Institute of Radio Engineers to be held March 22-25, 1948.

This article is an abstract and is presented here in its entirety.

In the study of physical phenomena it is frequently necessary to obtain a numerical distribution as a function of magnitude. It is the purpose of this paper to discuss electronic classifying, cataloging, and counting devices that have been used in studies of this type. Some recent advances have been made at the Clinton National Laboratory in these devices. In particular these advances have been made in the field of alpha energy determination.

In general a system for classifying, cataloging, and counting would involve (1) a device for translating the magnitude (size, energy, or brightness) of the particular event (or object) into a single voltage transient whose energy is proportional to the magnitude of the event under observation; (2) a device for discriminating against interfering phenomena; (3) a device for measuring the desired voltage transient; and (4) a device for determining the number of events in each increment of magnitude. The equipment for alpha energy determination consists of (1) a pulse type ionization chamber; (2) a low distortion, wide band amplifier; (3) and (4) one of several systems of pulse height analysers.

Three new analyser types have been developed, each of which performs all of the operations of classifying, cataloging, and counting. These three systems are the sweep analyser, the displacement analyser, and the synchronous analyser. The merits of each system will be discussed.

While these units were originally designed for alpha emission energy studies, they may be applied to any study where it is possible to convert the magnitude of each of the several events under observation into a single voltage transient. Some of the possible fields of application are galactic and extra-galactic studies in astronomy, particle size studies in chemistry and metallurgy, X-ray diffraction studies in crystallography, and energy studies in nuclear physics.

*MDDC - 1626 Thermal Neutron Absorption Cross Sections of Separated Isotopes, by Pomerance and J. I. Hoover 1 p., n. d., decl. 12/9/47.

For oral presentation before the January 1948 meeting of the American Physical Society, and for publication in the Bulletin of the American Physical Society.

This article is an abstract, the whole text of which is reproduced herewith.

The thermal neutron absorption cross sections of small samples of enriched isotopes have been measured in the Clinton pile oscillator. Some of the values (in barns) to be reported are as follows:

Ag^{107}	Ag^{109}	Ni^{58}	Ni^{60}	Fe^{54}	Fe^{56}	Fe^{57}
30.0	83.7	4.3	2.7	2.1	3.1	0.5

Normal isotopic mixtures of these metals were run in conjunction with the measurements on the separated isotopes as a check on the consistency of the results. Preliminary data on Mo indicate that about 80% of its cross section is due to Mo^{95}.

The values given above were obtained by comparing the unknown sample with a gold sample, for which a σ_a of 95 barns was assumed. Corrections for the isotopic impurities were made where possible.

The separated isotopes were supplied by the Y-12 Isotope Development Department.

MDDC - 1627 Considerations on the Existence of Element 61 in Nature, by N. E. Ballou, 3 p., December 22, 1947. (UCRL-26)

For publication as a Letter to the Editor of the Physical Review.

The possibility of existence of element 61 in nature is discussed in the light of reported radioactivities in this region. Calculations based on the Bohr-Wheeler theory indicate that isotopes of mass 145 and 147 should be the most stable ones of element 61.

MDDC - 1628 Heat Transfer in Film Boiling from Horizontal Tube, by L. Bromley, 30 p., September 1947 (EC-86)

Disposition as required for use in research, development, or manufacturing work and for possible publication in a technical journal.

By the use of the equation

$$h_{co} = \left[0.6\right] \sqrt[4]{\frac{k^2 \rho(\rho_l - \rho)\, g\lambda' Cp}{D \Delta t\, (Pr)}}$$

in combination with the equation

$$h = h_{co} + hr \left[3/4 + 1/4 \frac{hr}{h_{co}} \left(\frac{1}{2.62 + \frac{hr}{h_{co}}}\right)\right]$$

it is possible to calculate coefficients of heat transfer in film boiling to within the accuracy of the experiments on film boiling of nitrogen and water presented in the paper. The equations involve only the physical properties of the materials and hence should apply to the film boiling of any liquid whose physical properties are known or can be estimated in the vapor state.

Since film boiling is usually encountered in mercury boilers and may be encountered in any system where the surface temperature of the solid transferring heat to the boiling liquid is sufficiently high, this theory should make possible the accurate designing of such boilers.

In the above equations:

ρ = density of vapor, ρl = density of liquid, k = thermal conductivity, g = acceleration of gravity, λ' = difference in heat content between vapor at its average temperature and at its boiling point, C_p = specific heat at constant pressure, D = outside diameter of tube, Δ = finite difference, t = temperature, Pr = Prandtl number $= \frac{\mu C_p}{k}$, μ = viscosity of vapor, h = film coefficient of heat transfer, h_{co} = film coefficient of heat transfer if there were no radiation, hr = radiation coefficient of heat transfer.

MDDC - 1629 Mixed Oxide-Sulfides of Cerium and Thorium, by E. D. Eastman, et al., 12 p., July 24, 1945.

For use in lectures and seminars.

The preparation and properties of the two known oxide-sulfides of cerium and thorium, Ce_2O_2S and ThOS, are described, their relationship to the preparation and use of the pure sulfides of cerium and thorium being discussed. Evidence for the conversion of Ce_2S_3 from the Ce_3S_4 type crystal structure to the Th_2S_3 type crystal structure upon addition of oxide impurity is reviewed.

Mixed oxide-sulfide compounds are divided into three classifications depending upon crystal structure. Compounds with the same structure as the pure oxide are named thio-oxides to indicate substitution of the one or more of the oxygens by sulfur without change of structure. Compounds with the same structure as the pure sulfide are named oxy-sulfides to indicate substitution of one or more sulfurs by oxygen without change of structure. Compounds with structures different from either the pure oxide or pure sulfide structures are called sulfoxides.

*MDDC - 1630 Determination of the Melting Points of Plutonium Chloride and Plutonium Bromide, by T. O. Jones, 7 p., n. d., decl. 12/30/47. (ANL-JJK-14B-39)

To be included in the NNES (MPTS).

The melting points of $PuCl_3$ and $PuBr_3$ have been determined on samples purified by sublimation and found to be $760^\circ C \pm 5^\circ C$ and $681^\circ \pm 5^\circ$ respectively, confirming the results obtained at Los Alamos.

*MDDC - 1631 Note on the Preparation of Plutonium (III) Oxalate, by R. L. Patton, 1 p., n. d., decl. 1/6/48. (ANL-JJK-14B-51)

To be included in the NNES MPTS).

The entire report is presented here.

Plutonium (III) oxalate was one of the first compounds to be prepared from the lowest oxidation state of plutonium. Eight microliters of purple 0.027 M Pu (III) solution in 0.5 M hydrochloric acid was prepared by reduction of Pu (IV) with sulfur dioxide, and immediately upon the addition of 3.3 microliters of 0.1 M oxalic acid (1.5 moles/mole of Pu) a crystalline precipitate began to form which appeared to be purple under the microscope. After the solution had been kept at 0°C for several hours, the mother liquor was removed and the precipitate washed twice with 50% alcohol. A purple solution was obtained when the solid was dissolved in 6 N sulfuric acid.

MDDC - 1632 Fission Yields in Uranium 233, by E. P. Steinberg, J. A. Seiler, A. Goldstein, and A. Dudley, 20 p., November 1, 1947. (ANL-HDY-353)

For oral presentation at a meeting of the American Association for the Advancement of Science.

A survey of the radiochemical method for the determination of fission yields is presented. The yield-mass spectrum resulting from the slow neutron fission of uranium 233 is reported and the data are compared with similar spectra of uranium 235 and 239.

The accurate determination of fission yields by the radiochemical method involves a rather comprehensive study of the radiochemistry of the fission products, of their decay schemes, radiations, and genetics, and of the accurate measurement of fission rates and alpha and beta disintegration rates.

From the definition of fission yield given above, it follows that the absolute yield of a nuclide is given by

$$\text{yield (\%)} = \frac{\text{number of atoms formed directly and/or by decay} \times 100}{\text{number of fissions}}$$

The number of atoms formed is determined by radiochemical analysis for the nuclide. The number of fissions occurring in the sample of fissionable material during the neutron irradiation is determined by direct count in a pulse ionization chamber.

MDDC - 1633 Technique for Observing Nuclear Disintegrations and Scattering in Small Gas Volumes, by R. F. Taschek, 10 p., n.d., decl. 12/30/47. (LADC-473)

For publication in the Review of Scientific Instruments.

For the purpose of observing nuclear disintegration and scattering phenomena in small gas volumes and simultaneously providing a small neutron source, a gas target has been developed for use with the particles accelerated by the Los Alamos 2.5 Mev Van de Graaff generator. This target, which can be used for determining angular distributions of reaction products, is described. Data are shown for the deuteron-deuteron interaction.

*MDDC - 1634 Variable Energy Neutrons from Accelerated Particles, by A. O. Hanson and R. F. Taschek, 48 p., n. d., decl. 1/16/48, (LADC-470).

Disposition as required for use in research, development, or manufacturing work.

In the report the primary emphasis is put on those neutron sources which are almost certainly monoergic and for which the techniques for use have been well worked out.

The following is a list of figures given and discussed: (1) Range of neutron energies obtainable from various sources; (2) Representation of a nuclear reaction in the laboratory system; (3) Relations between velocity vectors and angles in laboratory and center of gravity system; (4-8) Nomographs; (9) Yield of neutrons in the forward direction from 40 kev lithium target; (10) Neutron energies in double energy region; (11) Neutron yield from 2 kev target at 120° and 135°; (12) Total cross section for Li^7 (p.n)Be^7 reaction; (13) Differential cross sections for the production of neutrons from the Li^7(p,n)Be^7 reaction in units of 10^{-24} cm^2 per unit solid angle in the laboratory system at a function of the angle of the neutron θ_n for various values of E_p; (14) Coefficients of the Legendre polynomials representing the yield and angular distribution in the center of gravity system. The units of the coefficients α_i are chosen so that

$$4\pi\,\sigma(\phi,E_p) = \alpha_o(E_p)\,P_o(\phi) + \alpha_1(E_p)\,P_1(\phi) + \alpha_2(E)\,P_2(\phi).$$ where

$\sigma(\phi,E_p)$ is the cross section for the production of neutrons per unit solid angle; (15) Rotating target for use with Li(p.n) reaction; (16) Relative neutron yields at 0° for various thicknesses of lithium targets; (17) Total neutron yield from thick D_2O ice target; (18) Angular distribution of neutrons from D_2O ice target at 200 kev; (19) Neutron yield from deuterons incident on 1.9 cm of deuterium gas at atmospheric pressure; (20) Total cross section for the production of neutrons from D(d,n)He^3 reaction; (21) Angular distribution of neutrons from D(d,n)He^3 reaction in the center of gravity system which can be expressed by the relation $N(\theta) = B(1+A\cos^2\theta)$. The coefficient A is shown as a function of the deuteron energy; (22) Cross section for total neutron yield from C^{12}(d,n)N^{13} reaction; (23) Neutron yield from V^{51}(p,n)Cr^{51}. (24) Neutron yield from Sc^{45}(p,n)Ti^{45}; (25) Energy spectrum of neutrons from 0.7 Mev deuterons on a thin lithium target; (26) Neutron yields from several elements.

MDDC - 1635 Chemistry of Element 93. VI. First Preparation and Solubilities of Some Neptunium Compounds in Aqueous Solutions, by T. J. LaChapelle, L. B. Magnusson, and J. C. Hindman, 25 p., n. d., decl. 1/14/48, (ANL-JJK-14B-15).

To be included in the NNES(MPTS).

Properties and preparations are given for some twenty-four neptunium compounds both in the solid state or as solutions. Where known, properties included are formula, color, crystal structure, density, solubility, and stability. Aqueous solutions of neptunium (III), (IV), (V), and (VI) have been made. From these solutions solid neptunium compounds of the +4, +5, and +6 oxidation states have been prepared which are similar to analogous compounds of uranium and plutonium.

MDDC - 1636 The Acute Toxicity of Some Zirconium and Thorium Salts in Rats, by L. T. McClinton and J. Shubert, 10 p., November 23, 1947, (ANL-HDY-382).

For publication in the Journal of Pharmacology and Experimental Therapeutics.

1. The acute toxicity in rats of the citrate and gluconate salts of zirconium and the citrate salt of thorium have been studied. The salts were administered by intraperitoneal injection in large single doses and in divided doses over an extended period.

2. The LD_{50}'s and the standard errors for the experiments were as follows:

a. Zirconium (citrate salt)	1.710 mgm/kgm ± 80
b. Zirconium (gluconate salt)	247 mgm/kgm ± 40
c. Thorium (citrate salt)	68 mgm/kgm ± 12

3. Rats which survived 36 hours following the injection of the zirconium and thorium salts invariably recovered and exhibited no toxic symptoms 6 months later. No effect of zirconium (citrate) on the blood was found, nor was any histological damage found.

4. As much as 3.650 mgm/kgm of zirconium (citrate) was tolerated by the rats when administered by intraperitoneal injection once daily in concentrations of 450 mgm/kgm.

*MDDC - 1637 The Preparation of Perfluorocarbons, by L. Spiegler, 172 p., n. d., decl. 1/27/48.

To be included in the NNES(MPTS).

Processes were studied in considerable detail, and equipment was designed for the: (1) Preparation of perfluoro-n-heptane (C_7F_{16}) by vapor phase fluorination of n-heptane (C_7H_{16}) with cobalt trifluoride (CoF_3); (2) Preparation of perfluorodimethyl cyclohexane (C_8F_{16}) by vapor phase fluorination of hexafluoroxylene ($C_8H_4F_6$) with cobalt trifluoride; (3) Preparation of perfluoro solvents and oils (C_xF_n) by: (a) vapor phase fluorination of lubricating oils with fluorine, over a contact mass of silver plated copper, (b) vapor phase fluorination of lubricating oils and kerosene fractions with cobalt trifluoride, (c) liquid phase fluorination of lubricating oils with silver difluoride (AgF_2); (4) Preparation of fluoro-waxes by: (a) concentration of residues obtained in 3 (a), (b) liquid phase fluorination of hydrocarbon waxes with silver difluoride.

Successful methods for the preparation and for the regeneration of spent silver and cobalt carriers in situ were developed.

Extensive studies were conducted to develop production controls and to assure proper quality of products produced. Precision distillation analyses, hydrogen contents, infra red spectrographic analyses, and specific inductive capacities of products were correlated to attain these ends. Large scale operations to a large extent successfully duplicated the laboratory and semi-works experience.

*MDDC - 1638 Unsteady-State Separation Performance of Cascades, by A. M. Squires, et al., 108 p., June 24, 1946.

To be included in the NNES(MPTS), and for possible publication in a technical journal.

The sections of the paper treat the following topics:

Section 1 consists of an introduction. Section 2 relates exact unsteady-state results for certain idealized cascades with the steady-state behavior of these cascades. (The methods of calculating the exact results are described in Sections 5 and 6.) A simple correspondence is discovered between the two types of behavior, and an approximate equation is given for the variation of top stage concentration with time when product is drawn at a fixed rate and the top stage concentration is below the steady-state value for the product rate in question. This approximate equation may be used for a wide variety of cascades of practical interest. Redistribution times are discussed briefly, with special reference to the case of a uniform concentration in a large number of stages at the top of the plant.

Section 3 gives an exact procedure for evaluating the loss in output resulting from a transient disturbance which upsets the steady-state distribution of light component in the cascade. This procedure is valid for a cascade of any design.

Section 4 discusses the problems connected with the search for an optimum start-up procedure for a cascade, such that the desired steady state is reached with a minimum loss of production.

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* MDDC - 1638 Unsteady-State Separation Performance of Cascades, by A. M. Squires, et al., 108 p., June 24, 1946. (Cont'd from page 87).

Section 5 gives the exact solution of the time-dependent problem for a special continuously tapered cascade (interstage flows monotonically decreasing with stage number counting away from the feed point), operating in the range of light component mol fraction small relative to one. The taper is chosen to resemble cascades of practical interest, and is specified by functions selected such that the solution of the time-dependent problem can be written as a gencralized Fourier Series of products of two elementary functions, one of time alone and the other of the stage number. The degree of taper of the special idealized cascade can be varied between wide limits by suitable choice of a parameter in the equation specifying the cascade's interstage flows. The square cascade (interstage flows constant throughout cascade) is included as a special case.

Section 6 gives an exact solution of the time dependent problem for square cascades operating in concentration ranges where mol fraction is not small relative to one.

Section 2, 3, and 4 can be read by the non-mathematical reader without reference to Sections 5 and 6.

* MDDC - 1639 Construction of a Hand-Contamination Counter and Radiation Monitor, by R. J. Watts, 12 p., October 26, 1944 (LADC-164).

Disposition as required for use in research, development, or manufacturing work.

Complete details are given for the construction of an instrument for the detection of α, β, or γ radiation to be used in routine checking of contamination on hands, clothing, etc., and in the monitoring of background radiation.

The apparatus consists essentially of four units: (1) a high-voltage supply (0 to 2000 volts); (2) a low-voltage supply with an amplifier and indicating meter; (3) a Geiger-Mueller tube; and (4) a thin-window counter.

The indicator may be any 0- to 1-ma meter; the Esterline-Angus 0- to 1-ma recording meter is particularly useful when the instrument is used as a monitor. Provisions are also made to operate a loudspeaker as an auditory indicator of counts. On the most sensitive scale an intensity of .0004 R/8hr will give a deflection of 20% of scale; on the least sensitive scale, .02R/8hr will give full-scale deflection. For α radiation, intensities of the order of 200 counts per minute may be easily detected.

A schematic drawing of the high-voltage supply is shown. The supply is of the voltage-regulated type that is commonly used in measuring devices.

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*MDDC - 1639 Construction of a Hand-Contamination Counter and Radiation Monitor, by R. J. Watts, 12 p., October 26, 1944 (LADC-164). (Cont'd from page 88).

The amplifier itself consists of 3 parts: (a) a feedback RC-coupled amplifier of two tubes, a 6J7 and 6SJ7; (b) a univibrator or rectangular-wave generator consisting of a 6SN7; and (c) a tube which gives an output proportional to the number of incoming pulses. The amplifier amplifies the pulses from G-M tube or hand counter. The size of this output pulse from the amplifier depends upon the size of the input pulse. The amplification may be adjusted by means of the potentiometer on the grid of the 6SJ7.

The G-M tube is the standard aluminum type commonly used. Since these tubes have a 5-mil wall, β radiation may be detected. Details for mounting the tube with a handle are given so that it may be used used for examination of shoes, clothing, etc.

Details and methods of assembling the thin-window counter are shown. Since this counter is rather unorthodox in construction the technique of assembling it is given in detail.

Either argon or methane gas may be used in the counter. Argon has the advantage of using a much lower voltage (around 1300 volts in this case) but methane, since it is much cheaper, is preferable.

No attempt to evacuate the counter is made. After the gas has flown through for a half hour or so the counter will begin to count; after two hours or so the counting rate becomes constant. No trouble has been encountered with microphonics with this counter and with no alpha contamination present the background count is close to zero.

*MDDC - 1640 Preparation of Plutonium Nitride, by B. M. Abraham, N. R. Davidson, and E. F. Westrum, Jr., 6 p., n. d., decl. 1/16/48. (ANL-JJK-14B-5).

To be included in the NNES(MPTS).

The substance PuN is obtained (a) when plutonium metal is treated with anhydrous ammonia at a pressure of one-third atmosphere at 1000°C, (b) when plutonium hydride is treated with ammonia at a pressure of one-third atmosphere at 650°C and slowly cooled in ammonia, (c) when $PuCl_3$ is treated with a stream of ammonia gas at 900°C. The fact that higher nitrides are not formed in reaction (b) indicates that plutonium higher nitrides are less stable relative to PuN than are the uranium higher nitrides relative to UN. The synthesis of PuN from $PuCl_3$ and NH_3 indicates that the heat of formation of PuN is comparable to that of CeN, i.e., 79 kcal.

MDDC - 1641 An Ion "Velocitron", by A. E. Cameron and D. F. Eggers, Jr., 9 p., n. d., decl. 1/14/48.

For publication in the Review of Scientific Instruments.

Short ion pulses of known energy are projected down a long, evacuated drift tube. Since the velocity is related to the charge, mass, and accelerating potential by the expression $v = \sqrt{2eE/m}$ it is, for constant conditions, inversely proportional to the square root of the mass. The time interval between the arrival of pulses of ions of masses m_1 and m_2 at the end of the tube will be proportional to $L(\sqrt{m_1} - \sqrt{m_2})$ where L is the length of the drift tube from ion source to collector plate.

The pulses may be amplified and applied to the vertical deflection plates of an oscilloscope tube whose horizontal sweep is tripped by the pulse which is applied to the ion source.

A block diagram and a detailed description of the apparatus are included.

In the experimental work the pulse applied to the ion source was never more than 5 microseconds wide but the observed peaks are from 20 to 30 microseconds in width. This indicates that the ions were not strictly monoenergetic or that they followed paths of different lengths. Improvements in source structure would undoubtedly reduce this effect but narrowing the control pulse reduces the intensity and therefore the sensitivity and this cannot be compensated for by increasing the inpute resistance of the pulse amplifier without unduly increasing the time constant of the first stage. The instrument does, however, lend itself to the display of a mass spectrum which can be readily observed even though it changes rapidly as a function of time.

MDDC - 1642 Electromagnetic Separation of Bromine and Chlorine Isotopes, by L. G. Chelius and C. P. Keim, 1 p., December 31, 1946.

For publication in the Physical Review.

The entire document is presented here.

The usual method of separating stable isotopes in the calutron is by collecting a beam of singly ionized particles in a chemical uncombined form such as Ag^+, Sn^+, etc. Bromine has been collected here using NaBr charge material and collecting the $NaBr^+$ particles. An analysis of the received material indicated $91.41 \pm 0.5\%$ Br^{81} and $8.59 \pm 0.5\%$ Br^{79} collected in the mass 104 position, while $90.54 \pm 1\%$ Br^{79} and $9.46 \pm 1\%$ Br^{81} appeared in the mass 102 position. This method has greatly simplified the collection of isotopes of elements which are gaseous at room temperature and which are not chemically inert. A scan of the mass spectrum indicated that the $NaBr^+$ was the strongest beam received, comprising approximately 30% of the bromine ions in the total beam. Chlorine has been separated in a similar manner using CuCl charge material and collecting the $CuCl^+$ particles in the mass 98 and 102 positions. Analyses of the received chlorine isotopes have not been completed at this time.

MDDC - 1643 The Origin, Detection, Identification, and Removal of Radioactive Contaminants in Tracers, by W. E. Cohn, 24 p., December 1947.

For publication in Chemical and Engineering News.

The physical and chemical principles underlying the origin, detection, and removal of radioactive impurities in tracer materials are discussed from the standpoint of the individual user. Specific examples, drawn from everyday experience, are given as illustrations of all general causes, techniques and procedures involved, to the end that tracer experiments may not suffer from the introduction of impurities and that the removal of such may be most conveniently and efficiently accomplished.

MDDC - 1644 Exchange of Uranium between UF_4 and UF_6, by A. V. Grosse, 14 p., September 1944. (XAC-S-1692).

For publication in the Journal of the American Chemical Society or in Industrial and Engineering Chemistry.

Exchange of uranium in UF_4 and UF_6 takes place with measurable velocity at 100°C.

The rate of exchange can be increased by a factor of ten by means of $HgCl_2$ as a catalyst.

The UF_6 combined with UF_4, to form UF_5 or $[UF_4 \cdot UF_6]$, exchanges much faster than free UF_6.

A process for enriching UF_6 with U^{235}, after it has been depleted in this isotope, by means of an exchange with UF_4-containing U^{235} in natural concentration, is discussed.

Data are given on the rate of exchange of uranous and uranyl sulfates and between solid UF_4 and uranyl sulfate in aqueous solutions.

MDDC - 1645 Slow Neutron Velocity Spectrometer Studies of Cu, Ni, Bi, Fe, Sn and Calcite, by W. W. Havens, Jr., L. J. Rainwater, C. S. Wu, and J. R. Dunning, 32 p., September 22, 1947. (A-3975).

To be included in the NNES(MPTS), and for publication in the Physical Review.

The thermal cross section of Cu is well matched by the curve $\sigma = (7.8 + 0.54\ E^{-\frac{1}{2}})$. Microcrystalline interference is observed in the low energy region. The cross section decreases slowly from 8 to 7.3 between 2 and 100 ev then decreases more rapidly until at zero timing it is 5.3. A small dip is observed near 3000 ev. The thermal cross section of Ni is well matched by the curve $\sigma = (17.0 + 0.77\ E^{-\frac{1}{2}})$. Microcrystalline interference effects are observed at low energies. The Ni cross section is approximately constant at 17.2 from 3 to 50 ev. A small dip is observed with a minimum near 100 ev. Above 100 ev the cross section drops rapidly to 8 at zero time of flight. Bismuth shows no 1/v slope in the thermal region because of microcrystalline interference effects. The free cross section of Bi is (9.0 ± 0.2) and is constant over the energy region investigated. The thermal cross section of Fe is well matched by the curve $\sigma = (11.0 + 0.35\ E^{-\frac{1}{2}})$. Microcrystalline interference effects are observed in the low energy region. The cross section of Fe remains approximately constant at 11 from 3 to 300 ev then decreases to 4.8 at zero time of flight. The cross section of Sn in the thermal region rises due to microcrystalline interference effects which mask any 1/v slope. The free cross section is $(4.9 + 0.1)$. There is a slight dip in the transmission curve of tin around 6 ev which may or may not be real. Other small dips near 50 and 100 ev are probably real. The cross section increases near zero time of flight indicating that there are probably resonances above 1000 ev. The cross section of a large Nicol prism decreases from the additive $CaCO_3$ cross section of 20 at short wave lengths to about 3.5 at .005 ev. The residual cross section cannot be explained by theory.

MDDC - 1646 Tungsten Wire Straightener, by A. A. Jarrett, 4 p., February 3, 1945. (CP-2572).

Disposition as required for use in research, development, or manufacturing work. This also includes declassification of the tungsten wire straightener.

Tungsten wire may be straightened by alternately heating and cooling the wire while it is under strong tension. The tungsten wire straightener described is a device which aids in straightening 5 to 9 mil diameter wire, by holding the wire under tension while it is electrically heated.

MDDC - 1647 The Effect of Lethal Dose of Total Body X-Ray on Uric Acid and Allantoin Excretion in Dogs, by H. Krizek, I. Silverbach, and S. Schwartz, 29 p., June 15, 1946. (CH-3851).

Disposition as required for use in research, development, or manufacturing work.

In five dogs given single lethal doses of total body X-ray, urinary excretion of uric acid increased 3 to 6½ days before death; allantoin excretion showed no significant change. Uricolytic indices, therefore, dropped during the terminal period. Uric acid excretion was determined in one dog given 12.5 r daily total body X-ray, and in one given a slowly lethal dose of plutonium, and showed a similar terminal increase. These changes are probably due to liver dysfunction.

In all dogs studied excretion of substances giving a color with the uric acid reagent but not destroyed by incubation with uricase showed no consistent change after irradiation.

Rabbits appeared to be poorly suited for study of purine metabolism.

*MDDC - 1648 The Preparation and Properties of High Polymers of Trifluorochloroethylene, by W. T. Miller, 2 p., n. d., decl. 1/19/48. (XAC-R-1717).

For oral presentation at a meeting of the American Chemical Society.

This report is an abstract and is presented here in its entirety.

High temperature thermoplastic polymers with desirable mechanical properties were prepared from trifluorochloroethylene. These materials were extremely inert chemically.

The polymerization of trifluorochloroethylene was carried out in bulk utilizing peroxide promotion. Polymer with a ball and ring softening temperature of the order of 300°C was generally utilized and could be fabricated by convertional procedures at this temperature. No methods were available for the direct determination of molecular weights due to the insolubility of the material, but the observed properties of the polymers were best explained by assuming very high molecular weights.

High polymer trifluorochloroethylene undergoes a phase transition at about 210°. Above this temperature the viscous properties are independent of the previous thermal history of the sample. However the low temperature physical properties of the polymer were strongly affected by the thermal treatment in the transition temperature range. Quenched samples were more transparent, softer and more flexible than those cooled slowly. A considerable useful variation in physical properties was obtainable by heat treatment and the quenched properties obtained were indefinitely stable at temperatures below 100°C.

MDDC - 1648 The Preparation and Properties of High Polymers of Trifluorochloroethylene, by W. T. Miller, 2 p., n. d., decl. 1/19/48. (XAC-R-1717). (Cont'd from page 93).

High polymer trifluorochloroethylene was insoluble in common solvents, but was swelled by low molecular weight chlorinated solvents such as trichloroethylene at their boiling points. Fluorocarbon solvents were comparatively ineffective in producing swelling.

MDDC - 1649 Uranium Hydride. II. Radiochemical and Chemical Properties, by A. S. Newton, et al., 20 p., n. d., decl. 1/7/48.

For publication in the Journal of the American Chemical Society.

The radiochemical properties of uranium hydride involving leaching of the fission products and the behavior of radioxenon were investigated. A general survey of the chemical properties of the hydride was made. This included its reactions with air, water, acids, oxidizing agents, heavy metal salt solutions, halogen-bearing gases, ammonia, phosphine, and other gases, the effects of solvents, and attempted reductions of organic compounds. A few of the reactions afforded excellent preparative methods for certain anhydrous uranium compounds, otherwise somewhat difficult to prepare. Some of the applications of uranium hydride and the hydride reaction are briefly listed.

MDDC - 1650 **Thermal Neutron Absorption Cross Sections for Separated Isotopes, by H. S. Pomerance and J. I. Hoover, 3 p., n. d., decl. 1/15/48.**

Oral presentation before the January meeting of the American Physical Society.

MDDC-1626 is an abstract of this report.

MDDC - 1651 **Rochester Ion Meter Construction and Operation Details, by W. F. Bale, 30 p., January 18, 1945. (II-188-7460).**

Disposition as required for use in research, development, or manufacturing work. This also includes declassification of the Rochester ion meter.

The instrument has been designed for detection and measurement of a group of ionizing radiations. Interchangeable ionization chambers have been designed and constructed for (1) beta and gamma radiation, (2) alpha radiation, and (3) alpha and beta radiation collected in precipitron tubes. The design and use of these auxillary chambers will be described in other reports now in preparation. There is also under construction a chamber designed for fast neutrons and gamma measurements that will give readings approximately proportional to the medical hazard involved.

Moderate to high intensities of radiation are measured by direct deflection of a microammeter indicating the plate current of a 1LN5 tube used as an electrometer tube. Low radiation intensities are measured by allowing the charge due to the ionization current to collect on one plate of a condenser. The other plate connects to the grid of the electrometer tube and to ground through a high resistance. During the period of charge collection the two condenser plates are electrically shielded from one another by a grounded metal vein inserted between them. On removing this vein the charge on the first plate of the condenser is communicated to the second plate and thus to the tube grid. A meter deflection then occurs proportional to the product of ionization current and the ion collection time.

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MDDC - 1651 Rochester Ion Meter Construction and Operation Details, by W. F. Bale, 30 p., January 18, 1945. (II-188-7460) (Cont'd from page 95)

The useful range of the instrument when using the constant deflection method is for gamma radiation from 0.3 r per 8 hours to 2.5 r per 8 hours; for beta radiation, from 1 U-unit to 14 U-units. By the "ballistic" method the useful range for gamma radiation is from 0.005 r per 8 hours to 1.8 r per 8 hours; for beta radiation, from 0.03 U-units to 9 U-units. In addition, by the use of a stop diaphragm on the chamber for beta measurements the range is extended to 70 and 45 U-units by the two methods.

Circuit diagrams, assembly drawings, and parts list are included.

MDDC - 1652 Low Pressure Alpha Counter, by W. B. Bennet, 4 p., December 1944. (CP-2206).

Disposition as required for use in research, development, or manufacturing work. This also includes declassification of the alpha proportional counter.

Difficulties with microphonics and beta background in existing alpha counters led to the experiments described. The object of this work was to investigate the possibility of using an air filled chamber operating at reduced pressure as an alpha counter. Specific goals were high resolving power, high beta tolerance, and elimination of microphonics.

One model was designed, built and tested. These tests showed that such a counter would have no microphonics, good resolving power and a high beta tolerance. However, this particular design had poor control of pressure, low geometry, a short operating region, and poor reproducibility. Since all of these faults can be corrected by improved design, it is felt that this type of counter can be made to give satisfactory results.

However no further work is contemplated since an atmospheric pressure methane proportional counter has been developed elswhere on the project.

The data obtained is summarized in the accompanying graphs.

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MDDC - 1652 Low Pressure Alpha Counter, by W. B. Bennet, 4 p., December 1944. (CP-2206). (Cont'd from page 96)

No. 1 shows the pressure operating range for various operating voltages; this graph indicates the great pressure sensitivity of the model studied, the sensitivity increasing with low pressure.

No. 2 shows the voltage operating regions for various pulse height selector settings at 12.3 cm pressure. At higher pressures the voltage operating range was observed to be shorter and steeper.

No. 3 shows the counter's approximate operating voltage at varying pressures of air and of argon.

A full scale drawing is included.

* MDDC - 1653 The Effect of Plutonium on Tissue Metabolism of Rats, by E. S. G. Barron, R. Abrams, R. D. Finkle, and R. P. Rhoades, 50 p., June 1946. (CH-3849).

To be included in the NNES(MPTS).

When plutonium is introduced into the body either by injection or by intratracheal instillation, there are, in addition to the usual signs of damage to the lymphoid tissues, definite alterations in the metabolism of tissues.

The spleen was the tissue most affected. It was considerably reduced in size. On intravenous injection, the QO_2, QO_2 succinate, and the anaerobic glycolysis were greatly depressed; there was also some diminution of the QO_2 pyruvate and Q pyruvate values. Following intratracheal instillation, there was some lowering of the QO_2 and QO_2 succinate values although not so marked as following intravenous injection. Following ingestion, the metabolism of the spleen remained normal.

The liver of rats treated with plutonium by the intravenous route showed marked macroscopic alterations accompanied by drops in the QO_2, QO_2 pyruvate, and Q pyruvate. When no macroscopic alterations were observed, there were lesser metabolic changes. There was some depression in the QO_2, Q pyruvate, Q butyrate, and on acetoacetate formation. Anaerobic glycolysis was somewhat diminished. In experiments with P^{32} as a tracer, it was found that the transport of P^{32} across the intestinal wall was normal; the synthesis of new phospholipid in the liver was not affected, yet its removal was significantly inhibited. The liver of rats receiving plutonium by intratracheal instillation showed normal QO_2 values and, in some cases, a depression of the QO_2 pyruvate and Q pyruvate.

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MDDC - 1653 The Effect of Plutonium on Tissue Metabolism of Rats, by E. S. G. Barron, R. Abrams, R. D. Finkle, and R. P. Rhoades, 50 p., June 1946. (CH-3849). (Cont'd from page 97)

The thymus of rats receiving plutonium by intravenous injection was considerably diminished in size on the fifth day after injection. The QO_2, more or less normal during the first five days, was considerably depressed afterwards. The QO_2 succinate was also low. After intratracheal instillation the metabolism of the thymus was less affected.

The metabolism of the adrenals was profoundly affected by intravenous injection of plutonium. There was at first a rise in the QO_2, followed on the fifth day by a large drop. After intratracheal instillation, the QO_2 was uniformly low. After ingestion of plutonium (ten times the intravenous dose), the metabolism of the adrenals remained normal.

Signs of kidney injury were observed following intravenous injection of plutonium. The blood NPN rose in a large number of the treated rats. The QO_2 was low in those animals having high blood NPN; the QO_2 glutamate and NH_3 formation were uniformly low. There was also, at times, a slight depression of QO_2 pyruvate and Q pyruvate. Following intratracheal instillation there was some rise in the blood NPN. The QO_2 remained normal, the QO_2 glutamate and NH_3 formation were uniformly inhibited, and the QO_2 pyruvate and Q pyruvate were slightly lower.

The QO_2 and QO_2 acetate of the heart remained normal up to the tenth day after intravenous injection of plutonium. There was some inhibition afterward.

The QO_2 of the submaxillary gland remained normal. In some animals there was diminution of the QO_2 succinate and QO_2 butyrate.

The lungs of rats receiving plutonium by intratracheal instillation showed definite areas of congestion. The QO_2 values of the macroscopically uninjured portions were normal in half of the animals; they were somewhat lower in the other half. The QO_2 succinate was low, while anaerobic glycolysis was normal.

Plutonium given by ingestion produced an inhibition of the metabolism of the small intestine. The QO_2, QO_2 succinate, and QO_2 pyruvate were low. Anaerobic glycolysis remained normal. The metabolism of the spleen and of liver remained normal. The blood picture also remained normal.

MDDC - 1654 Methods of Analysis in Preparation of Sulfide Materials, by L. Brewer, et al., 20 p., n. d., decl. 1/6/48. (MB-LB-18-4).

To be included in the NNES(MPTS), and also for informal disposition.

Details are given for the following analyses: (1) sulfur, oxidation number, and oxygen in sulfide materials by silver sulfide precipitation and hydrogen evolution; (2) sulfur and oxygen by combustion in O_2; (3) sulfur by ferric reduction; (4) sulfur by oxidation with bromine; (5) cerium in cerium sulfides; (6) cerium in thorium sulfides; (7) iron in sulfide material; (8) molybdenum in sulfide materials; and (9) sulfur in metals.

Reference is given for the analysis for oxygen in gases.

MDDC - 1655 Radiation Chemistry and Nuclear Energy, by M. Burton 14 p., n. d., decl. 1/22/48.

For publication in Chemical and Engineering News.

This document is a revision of MDDC-538.

A short summary is given of progress prior to 1939, followed by a discussion of developments under the Radiation Chemistry Section of the Metallurgical Laboratory at the University of Chicago and also by other workers in the field. It was the duty of this section to determine or predict the effect of anticipated intense radiation in and around the pile, in separation processes, and under various storage conditions, to indicate consequent limitations on procedures and materials, and to make necessary recommendations of methods to offset or avoid harmful effects of radiation. Secondarily, it had another function for the most part ignored until the end of the war, namely, to recommend useful chemical employment of radiation.

MDDC - 1656 Radiotoxicity of Inhaled or Ingested Radioactive Products, by W. E. Cohn, 15 p., n. d., decl. 1/27/48.

For publication in the Journal of Biological Chemistry.

The problem of disposing of radioactive wastes, posed most severely in the case of the fission and other radioactive products of the chain reacting pile, centers primarily about keeping the degree of contamination of the water, food and air supplies of populated areas below those concentrations which can cause biological damage. Since any production of a radioactive material anywhere at any time results in some degree of contamination of this kind, the first problems to be solved in setting the "tolerance" concentrations of radioactive isotopes in such media are: (1) the relationship between external concentration and internal deposition and (2) the relation between site of internal deposition, or passage, and biological effect.

The bodily deposition of an inhaled or ingested radioactive substance is governed by the metabolic behavior of the substance in question, particularly its degree of absorption from gut or lung, and the degree of concentration in and retention by one or another tissue. The relative hazard created by such deposition depends upon the physical properties of half-life, radiation type (α, β, or γ radiation) and radiation energy and upon the radiosensitivity and biological importance of each tissue involved.

In order to translate the information obtained from tracer experiments - to determine degree of absorption and pattern of tissue localization - and from radiotoxicological experiments - relating biological damage to tissue concentration - into tolerance concentrations in water, food or air, a general formulation is required which takes into account the variabilities in type of exposure (e.g., single or continuous intake, single or continuous pollution) and the variations in the metabolic behavior and biological effectiveness of each radioisotope and its compounds. The importance of the latter consideration - the biochemical individuality of each radiosubstance - is pointed up by the results of tracer studies with the fission products, which show that only iodine, barium and strontium are moderately well absorbed from the intestinal tract and, subsequently, firmly deposited in certain tissues, each with its own peculiar type of radiosensitivity. Because of these two factors, there arises the hazard of day-by-day accumulation of these radioelements up to a maximum set by the rates of decay and of excretion. When the latter are low (i.e., long half-life, low excretion rate), the possibility of building up toxic tissue concentrations from the continued intake of otherwise innocuous amounts of a radiosubstance arises.

This paper presents a general formulation which relates the concentration of a radiosubstance in air, water or food to the total dose or daily intensity of radiation received by a given tissue as a result of the type and extent of intake of a poluted source. This relationship is expressed in terms of the biological constants (degree of absorption, pattern of deposition, rate of excretion), and physical constants (half-life, radiation energy) of the contaminating substance. Only β-radiation is considered since γ-radiation, because of its low specific ionization, is much less dependent upon localization for biological effectiveness. However, the formulation presented is easily modified to take both α- and γ-radiation into account.

MDDC - 1657 The Electrodeposition of Plutonium, by O. Cook, 29 p., n. d., decl. 1/14/48. (MB-297).

For use in lectures and seminars and to be filed as a thesis in the University of California Library.

The optimum conditions for the deposition of uranium oxides (i. e., probably mixed UO_2 and U_3O_8) are temperatures above 80°C and a pH between 6 and 7. As an empirical rule for the successful deposition in acetate solutions it is apparently necessary to avoid ratios of uranium to acetate salts greater than 0.05.

The conditions for the electrodeposition of neptunium are probably very similar to those of uranium. Neptunium can be quantitatively codeposited with uranium oxides.

The conditions for the electrodeposition of plutonium are too similar to those of uranium to effect a quantitative separation. An indication was found that lower temperatures favor the deposition of plutonium. Plutonium, like uranium, cannot be deposited in a mercury cathode.

Plutonium cannot be quantitatively codeposited with manganese. This seems to indicate that the couple of plutonium metal to the reduced state is greater than the manganese-manganous couple. Since manganese is the most electropositive metal that has yet been deposited pure from aqueous solutions, it may be concluded that a method for the quantitative deposition of plutonium from aqueous solutions is not practicable.

Quantitative carrying of either oxidized or reduced plutonium by the anodic coprecipitation with MnO_2 is not possible.

MDDC - 1658 A Prophylactic Approach to the Anaphylactic Factors in Irradiation Disease, by J. B. Field and P. E. Rekers, 10 p., January 12, 1948. (M-2009).

For publication in the Proceedings of the Society for Experimental Biology, and for presentation at seminars of the Medical School of the University of Rochester.

Both of 2 dogs each given 25 mg benadryl or pyribenzamine three times daily beginning 2 weeks prior to exposure with 350 r single dose total body x-irradiation succumbed with typical severe signs of radiation disease. This compares with a mortality of 64 per cent (16 of 25) untreated dogs. Five of 10 rats given approximately 20 mg pyribenzamine daily succumbed 15 days after exposure to 750 r single dose total body irradiation compared with the death of 6 of 10 control rats at 10 days.

When ethylene disulphonate in distilled water was injected in various schedules, only 2 of 11 (18 per cent) dogs given 350 r single dose whole body x-irradiation succumbed. The treated animals in general had fewer signs of irradiation toxicity. However, when 450 r was the irradiation dose given, 4 of 5 (80 per cent) dogs succumbed compared with 3 of 4 (75 per cent) of untreated dogs. The injection of ethylene disulphonate into rats and rabbits which were irradiated did not affect the extent of toxic signs or the mortality.

* MDDC - 1659 The Ignition of U_3O_8 in Oxygen at High Pressures and the Crystallization of UO_3, by S. Fried and N. R. Davidson, 15 p., n. d., decl. 1/29/48.

To be included in the NNES(MPTS).

When samples of U_3O_8 or amorphous UO_3 are heated in oxygen under a pressure of 30-150 atmospheres at temperatures of 500°-750°C, they are converted to crystalline UO_3. Three crystalline varieties of UO_3 are formed. The least stable of these is hexagonal UO_3, the crystal structure of which is very closely related to that of U_3O_8. The most stable phase is isomorphous with the UO_3 prepared by the Mallinckrodt Chemical Co. by calcining uranyl nitrate.

The different varieties of UO_3 show markedly different stabilities with regard to decomposition into lower oxides in the presence of oxygen under one atmosphere pressure at 600°C-800°C. The most stable UO_3 phase remains unchanged at 700°C but decomposes to U_3O_8 at 800°C. The less stable, amorphous UO_3 decomposes at 620°C to $UO_{2.959}$ which is tan in color. At 625°C-630°C, the composition is reduced to $UO_{2.82}$ and at 650°C, the decomposition to U_3O_8 is essentially complete. These observations appear to explain the vastly discrepant reports in the literature as to the temperature at which UO_3 decomposes to U_3O_8.

Samples of UO_3 prepared elsewhere by the vapor phase oxidation of U_3O_8 with nitric acid gave X-ray patterns different from those of any of the three phases prepared by ignition of U_3O_8 in oxygen under high pressure. One of these samples when treated at 600°C with oxygen of atmospheric pressure "disproportionated" into a mixture of U_3O_8 and Mallinckrodt UO_3.

MDDC - 1660 Search for Elements 94 and 93 in Nature - Presence of 94^{239} in Carnotite, by C. S. Garner, N. A. Bonner, and G. T. Seaborg, 6 p., August 26, 1942. (MB-GTS-27).

For publication in the Journal of the American Chemical Society.

This report describes further attempts to find a long-lived isotope of the element 94 (as well as 93) in nature. In the present work, samples of carnotite, (a potassium-uranium vanadate), fergusonite (a rare earth-uranium columbate tantalate) and hatchettolite (a uranium columbate-tantalate) were subjected to chemical treatment designed to separate elements 94 and 93 from members of the uranium, thorium, and actinium radioactive series which would interfere in the detection of alpha- and beta-activity from the former. The final fraction from each ore in the form of a thin sample was tested for alpha- and beta-radioactivity. These experiments indicate the probable presence of 94^{239} in carnotite. In case there might be present isotopes of 94 and 93 which were not alpha- or beta-active, tests for fissions with slow neutrons and with fast neutrons were made. Since it is likely that any isotope of 94 and 93 would either undergo fission with slow neutrons with a cross section of the order of that of U^{235} or with fast neutrons with a cross section of the order of that of U^{238}, the presence of an amount of 94 or 93 of the order of one microgram could be established by such neutron fission tests. In the present work no detectable amounts of 94 or 93 were found by these neutron tests.

*MDDC - 1661 **Columbia Scaling Circuits, by H. A. Giassford and J. R. Dunning, 18 p., May 2, 1944. (A-1275).**

Disposition as required for use in research, development, or manufacturing work.

The advantages of high scaling ratios in counting random pulses are discussed. The mechanism of the basic circuit used in the Columbia University scaling circuits is described. The difficulties experienced in the performance of the earlier circuits are indicated and modified circuits to eliminate these difficulties are given. Precautions that must be observed in carrying out the constructional details are suggested. The complete circuit and specifications are given in detail for a Scale of 128 for use with linear-amplifier systems.

MDDC - 1662 **Optical Properties of UF_4, by W. W. Harris and R. A. Wolters, 12 p., November 5, 1947. (K-80).**

To be included in the NNES(MPTS), and for publication in American Chemical Society Journal.

The purpose of this study was to obtain optical constants which might be useful in identifying UF_4 in samples which are either too small to be analyzed chemically or samples which are too valuable to be used for a chemical analysis.

The conclusions presented are based upon observations made with white light and at 25°C. All data were obtained with standard instruments available in most laboratories, using the techniques of chemical microscopy.

Principle indices of refraction, crystal system, and habit of UF_4 crystals as obtained by optical methods are reported. Samples of UF_4 from different sources were examined.

UF_4 is monoclinic, occurring as flat six sided tablets, as triangular needles twinned parallel to the long direction of the crystal, and as dendrites. Refractive indices: $\alpha = 1.552$, $\beta = 1.584$, $\gamma = 1.598$. Optic angle is 6.' and optic sign is negative.

*MDDC - 1663 Aberrant Tissue Developments of Rats Exposed to Beta Rays - The Late Effects of P^{32} Beta Rays, by P. S. Henshaw and R. S. Snider, 29 p., n. d., decl. 1/29/48.

For publication in Radiology.

White Spargue-Dawley rats were exposed to beta radiation from artificially radioactive sources. These sources were fabricated of amorphous red phosphorus embedded in an equal amount, by weight, of phenolic-formaldehyde resin, the mixture being cast in sheets roughly 0.2'' thick. The plastic sheets were then cut to specification and activated in the chain-reacting pile. Exposure rates were measured by a variety of instruments calibrated against an extrapolation chamber as a standard. Treatments were of two types: (a) single massive exposures ranging from 1.5 to 10 x 10^3 rep and (b) smaller exposures given six times per week which ranged from 0.5 to 625 rep per day.

Depending upon the amount of exposure, various disturbances of the skin tissue began to appear about 1 week after treatment. These were about what would be expected from acute irradiation injury of the skin. Reasonably satisfactory repair occurred in those animals which survived the acute injury. Exceptions to this were the eyes, many of which became opaque, and the external ears which, because of the geometry of exposure, received excessive doses and were destroyed. Daily treatments did not produce the acute types of injury except at the highest exposure level. At this level the acute symptoms developed gradually and there was no recovery.

Several months after an apparent recovery from acute injury or after daily treatments started, a remarkable variety of cutaneous and subcutaneous tumors became manifest. Practically every type of tumor that can arise from skin and connective tissue was seen, different types often being found side by side on the same area of skin. Epithelial tumors, almost absent in controls, were found in large numbers after certain treatments. Subcutaneous tumors occurred in half the female controls and rarely among the males; irradiation increased this incidence but little in the females and many fold among males. Exposures of 4,000 to 6,000 rep or 50 rep per day seemed optimal for production of malignancies.

In addition to the tumors noted, other forms of tissue abnormalities were seen. Double or triple claws, chitinous projections, or soft tissue extensions were found so frequently that radiation rather than chance seemed to be the cause.

MDDC - 1664 The Clinton Pile Oscillator, by J. I. Hoover, et al., 15 p., n. d., decl. 1/26/48.

For oral presentation before a meeting of the American Physical Society held in New York, January 29-31, 1948.

The pile oscillator is a device for measuring neutron absorption cross sections.

The Clinton pile oscillator has undergone a number of changes during its development and it is described in its present state in which the absorber is oscillated in close proximity to the ion chamber.

The oscillator consists essentially of a mechanical device to oscillate the sample, a neutron sensitive detector (i.e., ion chamber), and an electrical pick-up system to convert the alternating voltage pulse generated within the chamber to a quantity which is readily measured.

The mechanical parts of the oscillator consist of a washing machine gear box on the shaft of which is mounted an aluminum pulley wheel 30" in diameter, which is capable of oscillating through 180°.

Two types of ion chambers have been used, Type A consists of an aluminum tube 10" long and 1" o.d. which was coated internally with a 2-2.5 mg/cm^2 of enriched B^{10}. The central "wire" is a 1/4" aluminum rod insulated from the tube by means of quartz spacers and connected to the B^+. Type B chamber consists of three concentric aluminum tubes the innermost of which was 27" long and 7/8" o.d. The latter was coated inside and out with 0.5 mg/cm^2 of enriched B^{10}, was insulated and connected to the B^+ voltage of the battery pack.

A resonance galvanometer method and an integrator method have been successfully used to measure the voltage pulses from the ion chamber, but the integrating method was adopted.

In making the measurements the sample of unknown cross section is oscillated about the center of the ion chamber for a predetermined number of cycles and the voltage across condenser C is measured. The number of mm^2 of cross section of gold that causes the same voltage to appear on C when oscillated for the same number of cycles, is equivalent to the number of mm^2 of cross section of the sample. The unknown cross section can then be calculated from the formula $N_x \sigma_x = N_{au} \sigma_{au}$ where N_x is the number of atoms of the sample and σ_x its cross section, N_{au} is the number of atoms of gold and σ_{au} the gold cross section.

MDDC - 1665 A Study of the Reaction between Beryllium and Aurin Tricarboxyllic Acid, by G. E. Kosel and W. F. Neuman, 14 p., April 1947. (M-1965)

For publication in the Journal of the American Chemical Society.

The properties of the colored complex of aluminon and beryllium in alkaline solution were studied spectrophotometrically. The color intensity has been found to vary with dye concentration, pH, and temperature. From these studies, a procedure has been developed for the determination of beryllium in 1-10 microgram amounts.

The accuracy of this method in its application to pure beryllium is shown. The errors are greater than are to be desired, but the method may be useful in the absence of more accurate methods. Isolation of the beryllium will be necessary in its applications to analysis of biological materials, ores, etc., due to the interference of common cations as described above.

The fact that the dye itself is appreciably colored in high dilution indicates that the method cannot be extended to analyze smaller quantities.

MDDC - 1666 Fluorescense Studies of Plutonium, Neptunium, and Americium, by G. R. Price, 21 p., August 13, 1946. (CN-3545).

Available for use as material for seminars.

The work on plutonium described in the report was undertaken in the hope that a fluorescence method of analysis for plutonium could be developed that would be as satisfactory as the fluorescence method of analysis for uranium.

A number of compounds of plutonium, neptunium, and americium were tested for luminescence. The conditions employed included irradiation with visible and infrared light, dry ice and liquid nitrogen temperatures, and solution in organic solvents and fused salts; a special search was made for infrared resonance fluorescence of the plutonyl ion. In no case was conclusive evidence of luminescence found.

If plutonium behaved similarly to uranium and most rare earths, fluorescence would have been observed in the experiments described, since in these the conditions were favorable for uranyl and rare earth fluorescence. The plutonium concentrations employed ranged from 0.0003 to 0.04 M, with the greater part in the range of 0.001 to 0.01 M.

MDDC - 1667 The Beta Spectrum of W^{185}, by D. Saxon, 4 p., December 23, 1947. (ANL-HDY-385).

For publication as a Letter to the Editor of the Physical Review.

The β spectrum of W^{185} was measured in a 180° β spectrometer. A sample of WO_3 was irradiated, a month allowed for the 24 hour activity to decay, and the spectrum measured. The decay indicates a half-life of 72 ± 3 days, no impurities of other half-lives being present. The linear extrapolation of the Kurie plot of the Fermi theory gives the endpoint energy 0.430 ± 0.010 Mev.

Below 0.3 Mev, the plot deviates from the linear section, gradually rising above it. If the deviation was due to a weaker β of 0.3 Mev, its intensity relative to the 0.43 Mev β, would be ~15%. However, from the thickness of the source used, 3.85 mg/cm^2, it is more probable that most of the deviation is due to the source scattering.

Using the values for the endpoint and half-life found, W_0 = 1.84 and half-life = 72 days, ft is changed to 0.28×10^8, leaving W^{185} in the second forbidden group.

MDDC - 1668 The Beta Spectrum of Au^{198}, by D. Saxon, 6 p., December 1947. (ANL-HDY-384).

For publication as a Letter to the Editor of the Physical Review.

The beta spectrum of Au^{198} has been measured in a 180° beta spectrometer. The decay of the irradiated Au solution indicates a half-life of 2.66 ± 0.01 days, no impurities of other half-lives being present. The linear extrapolation of the Kurie plot of the Fermi theory gives the endpoint energy 0.960 ± 0.005 Mev. Using the new endpoint, W_0 = 2.88, ft becomes 0.18×10^8, leaving Au^{198} still empirically second forbidden. The Kurie plot, however, is linear back to 0.2 Mev, indicating an allowed spectrum shape. Thus the total forbidden connection factor must be constant. One possible explanation for this is that the observed allowed spectrum is the sum of two or more forbidden spectra; though recent coincidence measurements verify the simple shape found. The present data gives an upper limit for the neutrino mass γ = 15 kev, or γ = 0.03 the electron mass. K and L internal conversion peaks give a gamma energy of approximately 0.40 Mev; the rough conversion coefficients are approximately 1%.

MDDC - 1669 Laue Photography of Neutron Diffraction, by C. G. Shull, M. C. Marney, and E. O. Wollan, 9 p., n. d., decl. 1/21/48.

For oral presentation before a meeting of the American Physical Society held in New York, January 29-31, 1948.

The Laue method of showing crystal diffraction effects in which a single crystal is irradiated with a beam of X-rays, electrons, etc., having a continuous distribution of wavelength has been widely used by crystallographers. It has been possible to photograph the Laue pattern for a number of crystals using a collimated beam of neutrons emerging from the Clinton pile.

A schematic diagram of the experimental arrangement used is given. A beam of thermal neutrons containing a distribution of wavelengths between 0.5 and 3 angstroms is collimated through a 2-foot long shield block with a final limiting aperature of diameter 1/4 inch. The crystal is mounted across the beam and the Laue pattern is recorded on a sheet of X-ray film aligned perpendicular to the axis of the collimated beam and placed with a crystal to film separation of 6.3 cm. X-ray film by itself is quite insensitive to neutrons so that it is necessary to place some activating substance next to the film to produce darkening at the Laue spot positions. A sheet of indium has been used for this purpose and the beta-particles given off upon neutron capture in indium darken the film at positions where a neutron beam has been diffracted.

Laue patterns for NaCl, LiF and $NaNO_3$ as taken by the above procedure are given. The former two crystals possess face-centered cubic structures and the primary neutron beam was passed through the crystal parallel to one of the crystallographic axes. The four-fold symmetry in the Laue pattern for NaCl and LiF is a consequence of this method of examination. On the other hand $NaNO_3$ possesses a rhombohedral structure and this results in a more complicated Laue pattern.

The Laue spots for NaCl and LiF have been indexed and the neutron wavelengths characteristic of each spot have been calculated.

A graph shows the spectral distribution of radiation emerging from (a) an X-ray target operating at 40 kv and (b) a thermal neutron source at a temperature of 500°K.

Some tests were made to determine the optimum thickness of indium foil and to compare indium with other activating materials.

MDDC - 1670 Mass Spectrometer for Leak Detection, by F. S. Stein and J. E. Binns, 13 p., n. d., decl. 1/26/48.

For publication in the Review of Scientific Instruments.

The development and construction of a mass spectrometer specially designed for use as a leak detector are described. Magnetic focusing, by means of a solenoid in the source and through the use of curved pole pieces in the analyzer, is utilized. Foremost of the advantages of this instrument over the sector-type used for the same purpose is the fact that the sensitivity of this instrument is maintained for longer periods of time.

*MDDC - 1671 Portable Battery Operated Two Stage Radiation Meter, by C. S. Wu and J. Rainwater, 16 p., October 3, 1944. (A-2131).

Disposition as required for use in research, development, or manufacturing work.

A portable battery operated electrometer tube circuit for use with an ionization chamber is described. The circuit employs two type 959 tubes. Departures from common circuit designs with 959 tubes make possible operation with an extremely low input grid current of about 10^{-14} amperes with a full scale output on an (0-50) microammeter corresponding to only about 0.125 volts input. The circuit was found to be quite stable and linear even when input resistors of 10^{11} and 10^{12} ohms were employed. Using 10^{12} ohms input resistance and a 2.9 liter air filled ionization chamber a full scale deflection on the output meter corresponds to only about 0.4 mr/hr gamma radiation intensity. This gives an excess of sensitivity for the detection of biologically unsafe gamma radiation intensities. For the detection of β radiation it was found that 36 mg U_3O_8 through thin paper plus 0.001" aluminum gave a deflection of 6 microamperes output current. This corresponds to about 0.07 microcuries for full scale deflection using 10^{12} ohms.

An experimental unit has been constructed and found to have excellent stability and linearity. After a short warm-up period the drift rate corresponds to about 3 microamperes per hour. Since the zero set adjustment is easily made this does not interfere with operation. The battery life corresponds to about 5 days continuous duty. New improved models of this circuit for general and special applications are described.

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* MDDC - 1671 Portable Battery Operated Two Stage Radiation Meter, by C. S. Wu and J. Rainwater, 16 p., October 3, 1944. (A-2131). (Cont'd from page 109)

Since the current sensitivity, input grid current, and stability obtained with this circuit using the comparatively inexpensive and easily obtained 959 tubes compares so favorably with the usual circuits involving the more expensive F. P. 54 or Western Electric D 96475 tubes, its use at the present time is of particular value.

MDDC - 1672 Ionizing Irradiation Disease and a Study of the Protective Nature of Flavonones, by J. B. Field and P. E. Rekers, 42 p., January 19, 1948. (M-2010). (See also MDDC-1219)

To be presented at seminars of the Medical School of the University of Rochester, and for publication in the Journal of Experimental Medicine.

In dogs given 350 r of single dose total body x-irradiation, 64 per cent (16 of 25) of untreated animals died, while, when a preparation from lemon peel was administered continuously pre- and post-radiation, 26 per cent (4 of 11) of the animals succumbed. When the flavonol glycoside, rutin, was administered continuously pre- and post-radiation, 10 per cent (3 of 25) of the animals succumbed.

Clinical signs and post-mortem evidence of a hemorrhagic diathesis were most prominent in the untreated irradiated dogs. A generalized purpura was observed in the post-mortem examination of dogs treated with lemon peel extract and rutin, but the clinical signs of petechiae and spontaneous purpura in all of the treated animals were significantly reduced.

The red blood cells of dogs given 350 r single dose total body x-irradiation did not develop increased fragility. The rate of anemia production and increased sedimentation rate was reduced with ruthin therapy. In dogs receiving rutin, there were observed significantly more erythroblast forms and nucleated red blood cells than seen in the blood of untreated controls. Untreated dogs exhibited a considerable increase in the reticulocytes in the post-radiation recovery period.

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MDDC 1672 Ionizing Irradiation Disease and a Study of the Protective Nature of Flavonones, by J. B. Field and P. E. Rekers. 42 p., January 19 1948. (M-2010).(See also MDDC-1219) (Cont'd from page 110)

In a small series of dogs given 450 r of single dose total body x-irradiation, signs of purpura and hemorrhage as a cause of mortality appeared less extensive than at 350 r x-irradiation. Rutin therapy neither provided a detectable reduction in clinical signs or mortality. Rutin, similarly did not prolong the survival of rats given 700-750 r single dose total body x-irradiation.

The administration of rutin to dogs failed to alter the rate and extent of urinary transmission of bovine albumin introduced intraperitoneally.

Using the 350 r single dose total body irradiation of dogs as an assay procedure the following flavone substances have been tested, hesperidin, hesperidin methyl chalcone and esculin. Only 17 per cent (1 of 6) of the hesperidin-treated dogs died while the remainder showed reduced purpuric manifestations when compared with untreated dogs. However, 67 per cent (4 of 6) of the dogs given hesperidin methyl chalcone and 50 per cent (3 of 6) of the dogs given esculin succumbed with typical major hemorrhagic changes.

It was found that only in the terminal state did as many as 48 per cent of 350 and 450 r single dose total body x-irradiation dogs evidence a septicemia. A wide variety of organisms were isolated.

It is suggested that a primary cause of death in the 350 r single dose total body x-irradiated dogs is vascular disintergration. In some as yet undetermined manner, rutin, and probably to a lesser extent, hesperidin, reduces or prevents this phenomenon. By supporting the irradiated animal until spontaneous recovery of inhibited synthetic functions ensues, the flavonol substances reduce the predictable mortality.

Of the dogs given large doses of ascorbic acid, 50 per cent (3 of 6) failed to survive when exposed to 350 r single dose total body x-irradiation. It is suggested that the existence of a "vitamin P" entity is supported by the present report, and the technique of x-irradiation to induce vascular disintegration is adaptable for direct assay of "vitamin P" potency.

MDDC - 1673 Production of Rarer Metals, by G. Meister, 16 p., n. d., decl. 2/11/48. (A-12308).

For publication in Metal Progress.

The rarer or less familiar elements considered are thorium, zirconium and uranium. All these metals were prepared more or less pure in the early part of the nineteenth century. Since that time purer raw materials were produced, improvements were made in these earlier methods and new methods were developed so that metals have been prepared in a purer state. High purity metals are desirable for industrial utilization and for the production of wire and sheet. The methods to produce these metals in the required purity are treated in detail.

General methods of preparing metals are reduction of oxides with hydrogen; reduction of oxides with carbon; reduction of oxides with calcium, magnesium, or aluminum; reduction of halides with alkalies or alkaline earths; thermal dissociation of compounds; and electrolytic reduction of compound in fused salts.

The hydrogen reduction method, although used successfully commercially in reducing tungsten and molybdenum oxides, fails completely in the case of thorium, zirconium and uranium. When the oxides are reduced with carbon the resulting metal generally has a high carbon content and is brittle. Reduction of oxides with magnesium generally produces a low grade metal powder, but when calcium is used, especially in the presence of calcium chloride, a fairly good metal is obtained. Alumino-thermic reductions of the oxides generally are violent and produce some beads of metal but usually the product is not satisfactory and often forms alloys with aluminum which are not easily decomposed.

The thermal dissociation of compounds, as the iodide, has been commercially used in the production of zirconium and produces a very high purity metal. The iodide is decomposed by a hot filament, usually tungsten, and the pure metal deposited thereon.

Deposition by fused salt electrolysis has been developed and it produces a good grade of powder especially in the case of thorium, uranium and tantalum.

*MDDC - 1674 The Crystal Structure of α-UF_5 and of β-UF_5, by W. H. Zachariasen, 7 p., June 1946. (ANL-FWHZ-119).

For oral presentation before the International Congress on Pure and Applied Chemistry, and to be included in the NNES(MPTS).

α-UF_5 is tetragonal body-centered with $a_1 = 6.512 \pm 0.001$A, $a_3 = 4.463 \pm 0.001$A. The unit cell contains two molecules and the calculated density is $\rho = 5.81$. Each uranium atom is bonded to six fluorine atoms. These UF_6 - octahedra are linked by shared corners into endless chains along the a_3-axis.

β-UF_5 is also tetragonal body-centered. The unit cell containing eight molecules has dimensions $a_1 = 11.450 \pm 0.002$A, $a_3 = 5.198 \pm 0.001$A. The calculated density is 6.45. The space group is I42d. A structure is proposed in which each uranium atom is bonded to seven fluorine atoms. Four corners in each UF_7-polyhedron are shared with adjacent polyhedra.

*MDDC - 1675 The Crystal Structure of U_2F_9 and $NaTh_2F_9$, by W. H. Zachariasen, 7 p., June 1946. (ANI FWHZ-122).

For oral presentation before the International Congress on Pure and Applied Chemistry, and to be included in the NNES(MPTS).

The compounds U_2F_9 and $NaTh_2F_9$ are cubic body-centered with four molecules per unit cell. The lattice constants and calculated densities are

	a	ρ
U_2F_9	8.4545 ± 0.0005A	7.06
$NaTh_2F_9$	8.705 ± 0.001	6.58

The space group is I43m (T_d^3). The eight heavy metal atoms per unit cell are at positions (xxx); $(\bar{x}\bar{x}x)$ with $x = 0.187 \pm 0.004$.

Reasonable positions for the fluorine and sodium atoms are given. There are nine fluorine atoms about each heavy atom and six fluorine atoms about each sodium atom. The mean interatomic distances are: U-F = 2.31A, Th-F = 2.40A and Na-F = 2.34A.

MDDC - 1676 Stars in Photographic Emulsions Initiated by Deuterons. Part I. Experimental, by E. Gardner and V. Peterson, 16 p., January 5, 1948. (UCRL-28).

For publication in Physical Review.

Photographic plates have been bombarded with deuterons in the 184" Berkeley cyclotron, and a group of 1200 stars in the emulsion has been studied. The group included 300 stars at each of the following energies: 35 Mev, 90 Mev, 130 Mev, and 190 Mev. At each of these energies the average number of prongs per star was close to 3.0. About three times as many prongs were observed in the forward direction of the beam as in the backward direction. The study was made with desensitized plates, which do not show tracks of high energy protons. The results are to be interpreted as including all alpha particles and heavier nuclear fragments but only the lower energy protons.

* MDDC - 1677 Stars in Photographic Emulsions Initiated by Deuterons. Part II. Theoretical, by W. Horning and L. Baumhoff, 27 p., January 5, 1948. (UCRL-29).

For publication in Physical Review.

The theory of high energy nuclear stars depends on a theory of nuclear transparency and on a theory of nuclear evaporation. The transparency can be computed on the basis of a proposed model as soon as the interactions between the nucleons and the incident particle are known. The evaporation can be computed on the basis of the statistical model of the nucleus as soon as the nuclear entropy and binding energies of the evaporated particles are known. The calculations have been formulated with approximate values for the above interactions, entropies, and binding energies; and by means of various mathematical methods: a method of averages, a method of reaction integrals, and one using diffusion equations. Probability distributions have been obtained for the number of prongs per star, and distributions are being computed for the energy and angle of a prong. The results are in qualitative agreement with the observations on photographic emulsions described.

*MDDC - 1678 A Constant Current Regulator, Los Alamos, 2 p., n. d., decl. 1/29/48. (LADC-437).

Informal disposition as required for use in research, development, or manufacturing work. The entire text of the report is presented here.

A circuit has been developed to regulate the direct current through a beam-analyzing electromagnet The degree of regulation is approximately one part in ten thousand throughout the operating range, one-half ampere to three amperes. The magnet current is only about one-ten thousandth as sensitive to changes in circuit parameters as it is without the regulator.

Regulation is achieved by the control of a bank of power triodes (eight parallel 6AS7's) in series with the magnet. A direct-coupled amplifier (gain~10,000) compares the voltage developed by the magnet current across a Manganim shunt to a standard voltage derived from a dry-cell battery. Any unbalance between these two voltages is amplified and drives the grids of the control tubes in such a manner as to minimize the unbalance.

The three equations which express the change in magnet current with changes in supply voltage (E); magnet resistance (R); and amplifier gain (g) are, for I = 2 amperes:

$$\Delta I = 2 \times 10^{-6} \Delta E$$

$$\Delta I = 4 \times 10^{-6} \Delta R$$

$$\Delta I = 6 \times 10^{-9} \Delta g.$$

A circuit diagram is included.

MDDC - 1679 **Fission Excitation Functions**, by J. Jungerman and S. C. Wright, 6 p., June 10, 1947. (BP-92).

For publication in Physical Review.

The absolute cross sections for fission for bombardments of α -particles and deuterons on thorium and uranium were measured for the energies available at the 60 inch Berkeley cyclotron using the recoil method. Comparison with the theory of Bethe and Konopinski for the total cross sections shows that there is more competition present with the fission process for the bombardments on thorium than on uranium.

MDDC - 1680 **Utilization of Nicotinic Acid and Its Amide by the Human Erythrocyte in Vitro**, by E. Leifer, J. R. Hogness, L. J. Roth, and W. Langham, 10 p., n. d., decl. 1/29/48. (LADC-486).

For oral presentation before a meeting of the American Chemical Society to be held on April 19, 1948, and for publication in the Journal of Biological Chemistry.

Using C^{14} tagged compounds, the transport of nicotinic acid, nicotinamide and p-aminobenzoic acid across the red cell membrane in vitro was investigated. It was found that nicotinic acid is quantitatively taken up by the erythrocytes and is fixed in the cells in a non-diffusible form, presumably as coenzyme. Isotope dilution techniques indicate that for two normal males approximately 5 micrograms of nicotinic acid will saturate the erythrocytes of 1 cc of whole blood. Nicotinamide and p-aminobenzoic acid, like nicotinic acid, are freely diffusible through the cell membrane, but differ from the acid in that al' but a relatively small amount (less than 1 microgram/cc of whole blood) can be removed from the cells by repeated washing. This confirms a marked difference in the utilizati m of nicotinic acid and its amide.

*MDDC 1681 Additivity of Lethal Effects of External Beta and Gamma Irradiation (Supplement to MDDC-498), by J. R. Raper and K. K. Barnes. 13 p., August 1947. (CH-3850).

To be included in the NNES(MPTS).

Experiments in which several hundred mice were exposed to added doses of beta and gamma radiations (described in MDDC-498) failed to answer definitively the question of the additivity of the lethal effects of the two radiations. These experiments did, however, indicate necessary refinements of experimental technique, and gave a basis for the development of quantitative determination of the additivity of the lethal effects of beta and gamma radiations.

In the experiments reported in this paper, CF_1 mice were exposed individually to beta rays emanating from "envelope", thick P^{32} sources. At the same time, within the lead-lined experimental tunnel of the Clinton Pile, the animals were exposed to gamma rays provided by the radiative capture of slow neutrons by cadmium. The length of time that the animals were exposed to the respective radiations could be controlled even though the exposures were simultaneous. Administration time of gamma rays for correct dosage was one-half as much (or less) as that for the administration of beta rays. Control was possible by two methods; (1) the intervals that the animals were in the P^{32} sources, and (2) the interval that the source assembly was situated in the slow neutron field.

Beta and gamma rays were added in the ratio of their respective median doses for acute lethal effect: 4700 rep of beta rays to 840 r of gamma rays. The added radiations were administered in 6 graded doses which covered the entire range of possible additivity. Data indicate that the additivity of the lethal effects of the two radiations is of the order of 50 per cent.

Evidence from the experiments does not permit the conclusion that the lethal effects of external beta and gamma radiations may not be completely additive.

*MDDC - 1682 The Effect of Crystal Orientation on the Scattering of Slow Neutrons, by R. G. Sachs and V. W. Myers, 10 p., December 1947. (ANL-HDY-369).

For publication in the Physical Review.

Although the transmission of slow neutrons through microcrystalline materials has been the subject of several investigations, the effect of non-random orientations of the microcrystals on neutron scattering has not been considered in detail. A simplified scheme is developed for taking account of the orientation effect when only a single symmetry axis needs to be considered. A comparison is made with the measurements of the transmission of slow neutrons through randomly oriented and extruded graphite. It is possible to obtain an estimate of the amount of crystal orientation in this instance.

MDDC - 1683 A New Photographic Material for Gamma-Ray Dosimetry, by H. O. Whipple, C. S. Hornberger, J. G. Hoffman, and J. F. Nolan, 16 p., n. d., decl. 1/28/48. (LADC-485).

For publication in the American Journal of Roentgenology and Radium Therapy.

The use of a commercially available film ("Adlux") in problems of gamma-ray dosimetry is described. The film has been shown to have an unusually wide range of recordable gamma-ray dosage, together with unusual uniformity and reproducibility. The technique of its calibration and use is described, and its applicability to clinical problems of gamma-ray dosage in radium therapy is suggested.

MDDC - 1684 Magnetic Moment of He^3, by H. L. Anderson and A. Novich, 4 p., January 5, 1948. (ANL-HDY-388).

For publication as a Letter to the Editor of the Physical Review.

The nuclear magnetic resonance apparatus used in the measurement of the magnetic moment of tritium was improved so that it could detect the nuclear magnetic moment of He^3. With this equipment and at a frequency of 28.02 mc. a resonance attributed to He^3 was found at 8640 gauss. The significance of this is discussed.

MDDC - 1685 Cross Section and Crystal Orientation in Extruded Graphite and Aluminum by G. Arnold, R. Sternheimer, and A. Weber, 4 p., May 1947. (Excerpt from CP-3801).

For publication in the Physical Review.

To test the Sachs-Goldberger equations for the effect on neutron cross section of non-random orientation of graphite microcrystals, the cross section of extruded graphite was measured with the slow neutron velocity spectrometer for the two cases of neutrons incident perpendicular and parallel to the extrusion direction.

In a similar experiment, the neutron cross section of a block of aluminum cut from a rolled rod was measured perpendicular and parallel to the axis of the rod. The results are discussed.

MDDC - 1686 The Beta and Gamma Spectra of Ga^{72}, by S. K. Haynes, 11 p., n. d., decl. 2/9/48.

For oral presentation at the January 1948 meeting of the American Physical Society held in New York City.

For related paper, see MDDC-1401.

The experimental curves obtained in an investigation of the beta- and gamma-ray spectra of Ga^{72} with a thin lens spectrometer are presented and discussed. Evidence is given for the existence of beta-particle groups with maximum energies of 3.15 Mev, (9.5 to 20%) 2.5 Mev, (8 to 18.5%) 0.955 Mev, (32%) and 0.64 Mev, (40%). The photoelectron spectrum indicates gamma rays of the following energies: 2.51 Mev (26%), 2.21 Mev (31.5%), 1.87 Mev (7.5%), 1.59 Mev (4.5%), 1.05 Mev (4.5%), 0.84 Mev (100%), 0.63 Mev (18.5%), and possibly a weak gamma ray at 1.25 Mev (2%). A conversion line appears at 0.68 Mev in the beta-ray spectrum but no corresponding line can be identified with certainty in the photoelectron spectrum. The conversion coefficient is probably between ten and fifty per cent indicating an isomeric state of considerable duration. A partial decay scheme of Ga^{72} is presented.

MDDC - 1687 The Isotopic Constitution of Europium, Gadolinium, and Terbium, by D. C. Hess, Jr., 20 p., December 2, 1947. (ANL-AJD-218).

For publication in the Physical Review.

The isotopic abundances of europium, gadolinium, and terbium have been determined electrometrically by means of a mass spectrometer. The abundances of europium isotopes of masses 151 and 153 were found to be 47.77 per cent and 52.23 per cent, respectively. For gadolinium, masses 152, 154, 155, 156, 157, 158 and 160 were found to have abundances of 0.21 per cent, 2.14 per cent, 14.86 per cent, 20.61 per cent, 15.66 per cent, 24.75 per cent and 21.77 per cent, respectively. Upper limits for the existence of other isotopes of the elements were determined.

MDDC - 1688 Improved Ion Exchange Method for Separating Rare Earths in Macro Quantities, by F. H. Spedding, et al., 2 p., n. d., decl. 2/4/48.

For publication in the Journal of the American Chemical Society.

Studies have been made using 0.1% citric acid solution in the pH range 5.0 to 5.5 for the elution of the rare earths from Amberlite IR-100 columns. Marked improvements were observed over the separations obtained using higher concentrations of citric acid at lower pH values. The shapes of the elution bands under the new conditions are nearly rectangular and one rare earth follows another with little overlapping.

MDDC - 1689 The Effects of Roentgen Rays on the Embryos and Larvae of the Chinook Salmon, by A. D. Welander, et al., 57 p., n. d., decl. 2/5/48. (UWFL-8).

For publication in Growth.

An evaluation was made of the effects of X-rays of 250, 500, 1,000, 2,500, 5,000, and 10,000 r on the eyed embryos of chinook salmon, Oncorhynchus tschawytscha, using criteria such as death rate; change in growth rate, of both body weight and length; development of the fins, eyes, coloration and other structures; edematous or other degenerative effects; and histopathological effects on the hemopoietic tissue of the kidney, spleen, gonads, and interrenal bodies.

Cell counts and other quantitative measures revealed that the gonads were the most sensitive to X-rays with the hemopoietic tissue second. Most tissues and organs reacted to X-rays of 1,000 r or more, indicating temporary retardation of development for the most part. Mortalities of 52.5% occurred in the 1,000 r group over the period of 125 days of investigation. Severe damage to the organs and tissues and 100% mortalities resulted from doses of 2,500 r or more.

MDDC - 1690 Radioactive Isotopes as Sources in Industrial Radiography, by G. H. Tenney, 26 pl, n. d., decl. 1/29/48. (LADC-440).

For publication in Industrial Radiography and Non-Destructive Testing.

The first part of the report describes briefly the basic facts of atomic structure, the transmutation in radium, the value of "half-life" in industrial radiography and the energy expressed in Mev's. It also mentions briefly various ways of bombarding atoms and of creating radioactive isotopes.

The second part describes the experimental work. Radio-lanthanum was used as source of radiation. The characteristic curves for the radiography of steel up to a thickness of 5 1/4 inches were developed and prints of radiographs of various objects are given.

MDDC - 1691 The Concentration of Isotopes of Chlorine by the Counter-Current Electro-Migration Method, by S. L. Madorsky and S. Straus, 19 p., n. d., decl. 6/28/46.

To be included in the NNES(MPTS), and published in the Journal of Research of the National Bureau of Standards Vol. 38, p. 185-189, February 1947.

A method, based on the principle of counter-current electro-migration, has been developed at the National Bureau of Standards for the separation of isotopes. The successful application of this method to the concentration of K^{39} and K^{41} from solutions of K_2SO_4 and KCl, suggested the possibility of concentrating the isotopes of chlorine by this method. The paper describes some experiments designed to concentrate Cl^{35} from a solution of NaCl.

The electrode sections were supplied with manually-controlled droppers, siphons and manually-controlled overflow cups. The cathode was of the flushed type receiving 1:30 NaCl solution in addition to a stoichiometric amount of 1:12 HCl. The electrodes were made of platinum gauze, about 4 cm^2 in area.

The boundary was maintained between 1:30 NaCl and 1:18 NaOH as the upper and lower liquids respectively in an annular space between the outer tube and the inside cooler.

The current in all the experiments was about 0.5 ampere and the voltage between the electrodes about 80.

(Cont'd on next page)

MDDC - 1691 The Concentration of Isotopes of Chlorine by the Counter-Current Electro-Migration Method, by S. L. Madorsky and S. Straus, 19 p., n. d., decl. 6/28/46. (Cont'd from page 122)

Glass bead packing did not stand up well because of the alkaline nature of the anode, but sand was satisfactory. Inserting fritted discs in the packing did not seem to make any difference. Results of all the experiments are in good agreement.

A concentration of Cl^{35} from the normal value of 75.76% to 80.7% was obtained in 474 hours. A maximum initial separation coefficient of 0.207×10^{-2} was obtained.

*MDDC - 1692 Radiation Meter Model "A", by R. Watts, 2 p., April 22, 1946. (LADC-456).

Disposition as required for use in research, development, and manufacturing work. This includes declassification of the instrument.

This report consists of a circuit diagram and a panel and chassis layout of radiation meter - Model "A".

*MDDC - 1693 Potassium Plutonium(III) Sulfates, by H. H. Anderson, 5 p., September 1947. (ANL-JJK-14B-74).

To be included in the NNES(MPTS).

Potassium and plutonium(III) in the presence of sulfate give a hydrate, potassium plutonium(III) disulfate pentahydrate, $KPu(SO_4)_2 \cdot 5H_2O$. A second complex was isolated as a white solid and identified as pentapotassium plutonium(III) tetrasulfate, $K_5Pu(SO_4)_4$.

A diagram of the potassium-plutonium(III)-sulfate system is given, in which the ordinate represents the ratio of potassium to plutonium atoms in the original solution, before precipitation, plotted on a logarithmic basis, and in which the abscissa represents the percentage of plutonium in the solid precipitate. Upon inspection of the curve in the region where a trisulfate complex could be expected, it is obvious that no $K_3Pu(SO_4)_3 \cdot (1)H_2O$ could be present in any detectable amount. It is indicated that the disulfate complex, $KPu(SO_4)_2 \cdot 5H_2O$, is much stronger than the tetrasulfate complex, $K_5Pu(SO_4)_4$; a huge excess of potassium over plutonium in the original solution is necessary before the composition of the solid agrees with the tetrasulfate formula.

Solubilities were measured, with the conclusion that Pu(III) is only slightly soluble in high concentrations of potassium sulfate.

*MDDC - 1694 Plutonium Project Record, Vol. 9B, Chapter 7, edited by N. Sugarman, Argonne National Laboratory, 281, p., n.d., decl. 2/16/48.

For use in lectures and seminars, and for inclusion in the NNES(MPTS).

This report is made up of a series of papers numbered MDDC - 1694-A to MDDC - 1694-TT. These are abstracted individually below.

*MDDC - 1694-A Zinc and Gallium Activities in Uranium Fission, by J.M. Siegel and L.E. Glendenin, 24 p., n.d., decl. 2/16/48.

One Zn and two Ga isotopes have been isolated from U fission products. They are 49.0±1h Zn^{72}, 14.25±0.1h Ga^{72} and 5.0±0.5h $Ga^{(73)}$. Zn^{72} has a fission yield of 1.5×10^{-5} per cent and decays with a 0.3 Mev β, an ~ 1.6 Mev β and a γ to Ga^{72}, which then decays to stable Ge^{72} by means of a 0.8 Mev β, an ~3.1 Mev β and an ~2.1 Mev γ. $Ga^{(72)}$ is formed in U fission with a yield of 1.0×10^{-4} per cent and decays to stable Ge with a 1.35 Mev β and no γ. $Ga^{(73)}$ has also been found in Th fission and has been prepared by n,p reaction on Ge. The existence of a 9d $Ga^{(72)}$ reported in the literature has been disproved.

*MDDC - 1694-B The 33m Br^{84}, by S. Katcoff, B. Finkle, and N. Sugarman, 6 p., n.d., decl. 2/16/48.

The 30m Br^{84} has been isolated from neutron-irradiated U. It was found to decay with a 33m half-life and to emit β particles with 5.3 Mev maximum energy. Its fission yield has been determined as 0.65 per cent relative to 6.1 per cent for 12.5d Ba^{140}.

*MDDC - 1694-C Search for Se^{79} and the Absence of Long-Lived Se Activities in Fission, by L.E. Glendenin, 4 p., n.d., decl. 2/16/48.

An investigation to determine the presence of long-lived Se activity in fission is described. If the isotope Se^{79} is assumed to be long-lived, the half-life must be $>7 \times 10^6$ y.

*MDDC - 1694-D Preliminary Study of the 17h $Zr^{(97)}$ Chain, compiled by C.D. Coryell, 2 p., n.d., decl. 2/16/48.

The chain 17h Zr → 75m Cb is a prominent one in fission. Considerations of fission yield and preparation by cross-bombardment show that its mass assignment is 97.

*MDDC - 1694-E Characteristics of 67h Mo and Absence of Long-Lived Mo + , by S. Katcoff, 5 p., n.d., decl. 2/16/48.

The maximum energy of the β spectrum of 67h Mo^{99} was determined to be 1.2 Mev, and the half-life of 67h was verified.

Upper limits to the fission yields were calculated for possible long-lived isotopes of Mo with assumed half-lives ranging from 10d to 1y. It was shown that if such isotopes are formed in fission, they must occur with fission yields of less than 0.1 per cent.

*MDDC - 1694-F Absence of Long-Lived Mo in Fission, by J.A. Swartout, 4 p., n.d., decl. 2/16/48.

In a search for long-lived Mo fission isotopes, only a very small amount of activity was found. From the experimental data, the fission yield for a Mo isotope of ~60d half-life was calculated to be $\sim 3 \times 10^{-9}$ per cent.

*MDDC - 1694 - G Discovery of the $\sim 10^6$y $43^{(99)}$ Isotope, II, by R.P. Schuman, 5 p., n.d., decl. 2/16/48.

A new 43 activity has been found in U fission. It has a β energy of about 0.3 Mev, determined by absorption measurements, and if it has a γ, the β to γ counting ratio is greater than ~700. Assuming that the isotope is the ground state of 5.9h 43^{99} (isomeric transition), it has a half-life of the general order of magnitude of 3×10^5 years, as roughly estimated from chemical yields.

*MDDC - 1694-H Note on a Long-Lived Element 43 Activity in Fission, by L E Glendenin, 3 p., n d., decl 2/16/48.

A long-lived element 43 activity was isolated from a fission product concentrate prepared from 1 kg of uranium which was irradiated in the Clinton pile. A soft β component with a range of 70 mg/cm^2 corresponding to an energy of 0.3 Mev and a hard β are presumed to be the long lived ground state of the 5.9h element 43^{99}.

*MDDC - 1694-I Discovery of Long Lived Ru Activities in U Fission, by B.L. Goldschmidt and I. Perlman 3 p., n.d., decl. 2/16/48.

The discovery of two Ru isotopes in U fission with half-lives of ~1 month and ~3 months is described. The decay of the ~1 month activity is characterized by a ~0.15Mev β. Harder radiations with a range of ~1300 mg/cm^2, corresponding to an energy of ~2 7 Mev, accompany the decay of the longer-lived Ru isotope. Gamma radiations appear to be present in both isotopes. A well-defined γ-ray of 0.4 Mev is present.

*MDDC - 1694-J Identification of a 4h Ru → 34h Rh Chain in Slow Neutron Fission, by N.R. Sleight, 4 p., n.d., decl. 2/16/48.

The presence of a 4.5h Ru activity in slow neutron irradiated U was demonstrated, and later the existence of the 4.5h Ru → 36.5h Rh decay chain was established.

*MDDC - 1694-K Characterization of the 4.5h Ru Produced in Fission, by W.H. Sullivan, N.R. Sleight, and E.M. Gladrow, 6 p., n.d., decl. 2/16/48.

The short-lived Ru activity identified in slow neutron fission was found to have a 4.5 ± 0.1h half-life. Absorption measurements in Al gave an end point of 550-600 mg/cm^2, corresponding to an energy of 1.4 Mev. Absorption measurements in Pb gave a half-value thickness of 7.4 gm/cm^2, corresponding to an energy of 0.75 Mev. The fission yield of this isotope was found to be 0.9 per cent.

*MDDC - 1694-L Characterization of the 36.5h Rh Daughter of 4.5h Fission Ru, by W.H. Sullivan, N.R. Sleight, and E.M. Gladrow, 5 p., n.d., decl. 2/16/48.

The Rh daughter activity of 4.5h Ru was found to have a 36.0-36.5h half-life. Absorption measurements in Al gave an end point of 208 mg/cm^2 (Feather comparison method), corresponding to an energy of 0.68 Mev. Absorption measurements in Pb gave a half-value thickness of 2.0 $\pm$ 0.2 gm/cm^2, corresponding to an energy of 0.33 Mev. The β/γ ratio, as determined from Al absorption curves, was $\sim$ 1200.

*MDDC - 1694-M Identification and Mass Assignment of a 4.5h Ru $\rightarrow$ 36.5h Rh Decay Chain in Neutron and Deuteron-Irradiated Ru, by W.H. Sullivan, N.R. Sleight, and E.M. Gladrow, 5 p., n.d., decl. 2/16/48.

A (4.5h) Ru$\rightarrow$36.5h Rh decay chain was identified in slow neutron and deuteron-bombarded samples of Ru. The mass assignment of the decay chain was limited to mass number 105 since no Ru isotope other than Ru^{104} could be activated by slow neutrons to produce a chain decay with two negatron-emitted activities. Conclusions concerning the incorrect identification and mass assignment of Ru and Rh activities reported in the literature were possible.

*MDDC - 1694-N Characterization of the 4.5h Ru Produced in Neutron and Deuteron-Irradiated Ru, by W.H. Sullivan, N.R. Sleight, and E.M. Gladrow, 6 p., n.d., decl. 2/16/48.

The short-lived Ru^{105} parent of the 36.5h Rh^{105} was found to have a 4.5 ±0.1h half-life, a β-ray energy of 1.4 Mev (a range of ~ 600 mg/cm^2 Al) and a γ-ray energy of 0.77 Mev (7.7 gm/cm^2 Pb half/value thickness).

*MDDC - 1694-O Characterization of the 36.5h Rh Daughter of 4.5h Ru Produced in Neutron- and Deuteron-Bombarded Ru, by W.H. Sullivan, N.R. Sleight, and E.M Gladrow, 9 p., n.d., decl. 2/16/48.

From many decay measurements it was concluded that the best half-life value for the Rh daughter of 4.5h Ru^{105} is 36.5h. The β and γ-rays energies were found to be 0.66 Mev (202 mg/cm^2 Al range) and 0.33 Mev (2.0 gm/cm^2 Pb half-value thickness), respectively. An X-ray of ~ 200 mg/cm^2 Al half-value thickness (~ 20 Kev) and soft electrons of ~ 50 mg/cm^2 Al range (0.2-0.3 Mev) were observed also. The most satisfactory explanation for the presence of these latter two radiations is that the 0.33 Mev γ ray is ~ 90 per cent converted.

*MDDC - 1694-P Identity of the 4.5h Ru→36.5h Rh Decay Chain Produced in Fission and in Neutron- and Deuteron-Ru, by W.H. Sullivan, N.R. Sleight, and E.M. Gladrow, 3 p., n.d., decl. 2/16/48.

The 4.5h Ru→36h Rh decay chain produced in fission was shown to be identical with the 4.5h Ru^{105} →36.5h Rh^{105} decay chain produced in neutron- and deuteron-bombarded Ru by comparison of their radiation characteristics. Thus, the fission decay chain may be assigned to mass number 105.

*MDDC - 1694-Q Identification, Characterization and Mass Assignment of a 42d Ru Activity in Neutron- and Deuteron-Irradiated Ru, by W.H. Sullivan, N.R. Sleight, and E.M. Gladrow, 11 p., n.d., decl. 2/16/48.

A 42 ± 2d activity was isolated in Ru, after bombardment of Ru with neutrons and deuterons. Absorption measurements showed that there were 0.2 Mev and 0.8 Mev β rays, a 20 Kev X-ray, a 0.53 Mev γ ray and 30-40 Kev electrons. From the experimental data and other considerations, the activity was assigned to Ru^{103}. Several possible decay mechansims were postulated to explain the presence of all the different radiations.

*MDDC - 1694-R Identity of the ~30d Ru Found in Fission with the 42d Ru^{103} Produced in Neutron- and Deuteron-Bombarded Ru, by W.H. Sullivan, N.R. Sleight, and E.M. Gladrow, 6 p., n.d., decl. 2/16/48.

The identity of the ~30d (40d) fission Ru activity and the 42d Ru^{103} produced in neutron- and deuteron-irradiated Ru was shown by the comparison of their half-life values and radiations.

*MDDC - 1694-S The 57m Rh Activity and Its Ru Parent, by W.H. Sullivan, N.R. Sleight, and E.M. Gladrow, 6 p., n.d., decl. 2/16/48.

The half-life of the Ru parent of 57m Rh was determined by performing a series of daughter extractions on a fission Ru source. A half-life of 48d was found. From these and other data and the work of other observers, the 57m Rh was found to be the isomer of stable Rh^{103} and the daughter of the 42d Ru^{103}. A reasonable decay scheme is postulated from the accumulated data.

*MDDC - 1694-T Short-Lived Ru-Rh Decay Chains, by L.E. Glendenin, 6 p., n.d., decl. 2/16/48.

The presence of a 4m Ru → 24m Rh chain in U fission, first reported by Born and Seelmann-Eggebert, is verified. This chain is shown not to be the antecedent of 13h Pd^{109} and is tentatively assigned a mass of 107. No Ru activities with half-lives between 4m and 4.5h are observed in fission, although the presence of another short-lived chain, ~4m Ru^{108} → very short Rh^{108}, may be indicated.

*MDDC - 1694-U A Note on the 9h Rh Activity in Fission, by N.E. Ballou, 1 p., n.d., decl. 2/16/48.

The entire report is given here.

Preliminary studies on the Rh fraction isolated from the U fission products indicate the existence of a 9h Rh activity. After a neutron-irradiation of UNH of about one minute, the Rh fraction was separated from the other fission products by means of the pyridine procedure. A β-decay curve, started 1.5 hours after the irradiation, showed the known 24m and 36h periods and a new 9h period. Aluminum and lead absorption curves indicated that a 1.3 Mev β and a 0.8 Mev γ are associated with the 9h activity.

Since Te contamination had previously been found difficult to eliminate, a Rh-Te separation was made on a portion of the 9h period by precipitating Te with H_2S from a solution 9 M in HCl and 2 M in pyridine. This has been found effective in separating Te from Rh. The Te precipitate contained only about 1 per cent of the activity, which indicated absence of appreciable Te contamination. Additional experiments must be done to prove conclusively that the 9h period is an isotope of Rh and not some other contaminant. Since the fission yields of Rh activities must be small, contamination by isotopes of much higher yields is a definite possibility. Therefore, a series of determinations of the specific activity of Rh with respect to the 9h period should be made by various chemical separation procedures.

*MDDC - 1694-V Absence of Long-Lived Rh in Fission, II. Upper I umit to the Fission Yield of 210d Rh^{102}, by J.A. Swartout and W.H. Sullivan. 6 p., n.d., decl. 2/16/48.

Negligible activity was found in a search for long-lived Rh fission products.

From the experimental data the upper limit for the fission yield of a Rh isotope of ~25d half-life was calculated to be $< 6 \times 10^{-7}$ per cent. If one assumes that all the activity is due to a Rh isotope of 200d half-life, the fission yield would be $< 5 \times 10^{-7}$ per cent. This sets a limit on the occurrence in fission of Rh^{102}, a shielded isotope.

*MDDC - 1694-W Search for Pd^{107} and Absence of Long-Lived Pd Activities in Fission. II. by L.E. Glendenin, 2 p., n.d., decl. 2/16/48.

An investigation of the presence of a long-lived Pd activity in fission is described. By assuming that Pd^{107} is long-lived, the lower limit of the half-life of this isotope is shown to be 3×10^8y. This result indicates the absence of long-lived Pd activity in fission.

*MDDC - 1694-X The 43d $_{48}Cd^{115}$, by L. Seren, et al., 12 p., n.d., decl. 2/16/48.

A 43d isotope of Cd has been discovered while irradiating Cd with slow neutrons. The radiation consists of β^--rays of energy ~ 1.5 Mev, with either no γ-rays or less than one 0.3 Mev γ per disintegration. By means of chemical separations, the radio-element was identified as Cd, and the mass assignment to $_{48}Cd^{115}$ was made by a fast neutron $In^{115}(n,p)Cd^{115}$ reaction.

*MDDC - 1694-Y Long-Lived Sn in Fission, by G.R. Leader, 14 p., n.d., decl. 2/16/48.

A long-lived Sn activity, with a half-life of 130d, was identified in the HEW plant dissolver solution. It was found to emit only β particles whose maximum energy, according to Feather comparison analyses, was 1.5-1.6 Mev. The energy distribution for the β particles appeared to be unlike that for RaE, with which the Sn activity was compared. Considerations relative to isotope assignment led to the conclusion that the activity is probably a nuclear isomer of either the 10d $Sn^{(123)}$ or 62h $Sn^{(121)}$ activity, both of which decay to stable Sb isotopes. The fission yield was observed to be 0.0012 per cent. If the 130d activity is isomeric with the 10d $Sn^{(123)}$ isotope, then a branching ratio of 1:4 is indicated.

*MDDC - 1694-Z The 93h Sb^{127} Activity, by N.R. Sleight and W.H. Sullivan, 4 p., n.d., decl. 2/16/48.

The half-life of Sb^{127} is 93h. The β energy is 1.2 Mev, and the γ energy, 0.72 Mev.

*MDDC - 1694-AA The Long-Lived Sb in U Fission, II, by C.W. Stanley and L.E. Glendenin, 11 p., n.d., decl. 2/16/48.

A long-lived Sb activity has been found in the fission products of U. This activity appears to be identical with the long-lived Sb activity first reported in fission by Campbell at Chicago and the 2.7y Sb recently reported by Leader and Sullivan at Hanford. The radiations are a 0.3 Mev β, a 0.7 Mev β, a 27 Kev X-ray and a 0.6 Mev γ (coincident with the 0.3 Mev β). The fission yield is 0.023 per cent for an assumed half-life of 2.7y. The same activity has been produced by neutron irradiation of Sn and is therefore assigned a mass number of 125.

*MDDC - 1694-BB Radiations from the 32d-72m Te^{129} Fission Chain, by T.B. Novey, 5 p., n.d., decl. 2/16/48.

The 32d Te^{129} has been isolated in U fission, and the radiations from the decay of the 32d excited isomer and its 72m daughter have been examined by Al absorption measurements.

The radiations found are a 1.6 Mev maximum energy β spectrum and a large amount of soft radiation, probably electrons caused by internal conversion of the γ -rays resulting from isomeric transition.

*MDDC - 1694-CC Characteristics of the 8d I^{131}, compiled by J.H. Goldstein, 6 p., n.d., decl. 2/16/48.

Study of the characteristics of the decay of I^{131} confirm the literature values: half-life 8.0d, β energy 0.6 Mev, γ energy 0.36 Mev. The U^{235} fission yield is about 0.45 per cent for I^{131} coming from 32h Te^{131*} and 2.3 per cent for I^{131} coming from 25m Te^{131} and short-lived precursors, or a total of 2.8 per cent.

*MDDC - 1694-DD Search for Long-Lived Iodine, by G.R. Leader and W.H. Sullivan, 6 p., n.d., decl. 2/16/48.

A search was made for long-lived I^{129} in a fission product sample which originally contained 40 curies of I^{131}. A small amount of activity, which had a half-thickness of 10 mg/cm^2, remained after 1 year of decay. This activity was assumed to be due to I^{129} rather than to contamination, and the unexpectedly large half-life of 4×10^9y was obtained for the isotope. It is more likely that the isotope has very soft β radiations and that it evaded detection in this study.

*MDDC - 1694-EE The Characteristics of the 9.2h Xe^{135}, II, by E.J. Hoagland and N. Sugarman, 4 p., n.d., decl. 2/16/48.

9.2h Xe^{135} was prepared from I^{135}, and the average half-life was found from GM tube measurements to be 9.3 ± 0.1 hours. Measurements made by use of an ionization chamber and an FP-54 circuit gave a value of 9.15 ± 0.05 hours.

A standard Al absorption curve of 9.2h Xe was taken, and the maximum β energy found by a Feather analysis was 1.0 Mev.

*MDDC - 1694-FF The Half-Life and Radiations of 13m Xe^{135}, by T.B. Novey and J.D. Knight, 5 p., n.d., decl. 2/16/48.

The short/lived Xe^{135*} has been isolated from U fission, and its half-life and conversion electron energy have been determined as 13m and 0.50 Mev, respectively.

*MDDC - 1694-GG A Note on the Mass Assignment of 33y Cs^{137}, by L.E. Glendenin and J.D. Knight, 2 p., n.d., decl. 2/16/48.

Preparation of 33y Cs^{137} is descirbed and its identity confirmed by an aluminum absorption curve. It is concluded from the experiment conducted that the 33y Cs is of mass 137.

*MDDC - 1694-HH Further Study of the 13d Cs Activity, by L.E. Glendenin, 7 p., n.d., decl. 2/16/48.

The 13d Cs is found in the fission of both U and Pu. The half-life is 13 ± 2d. The fission yield is 0.011 per cent in U and 0.089 per cent in Pu. The mass number is probably 136.

*MDDC - 1694-II A Note on the 18m Ba, by A. Goldstein, 1 p., n.d., decl. 2/16/48.

The entire report is given here.

While re-investigating the short-lived isotopes of Ba formed in fission, Hahn and Strassmann discovered that the "14m" Ba previously reported was a mixture of 18m Ba and 6m Ba. They showed that the 18m Ba decays to 3.5h La and that the 6m Ba decays to 74m La.

The 18m Ba has been isolated from U irradiated in the Argonne pile and its half-life has been verified. This isotope appears to have one or more γ rays associated with it. The value of 4.61 per cent has been determined for the fission yield of 18m Ba by Goldstein, Schumann, and Rubinson.

*MDDC - 1694-JJ Water Absorption Curve of the γ Radiation from 40h La^{140}, by L.S. Goldring, 7 p., n.d., decl. 2/16/48.

Studies were made of the absorption curve of γ radiations from La^{140} in H_2O in an effort to obtain a measurement of the energy of the hardest constituent of the γ spectrum. Measurements taken over the range 1.36 to 2.56m of H_2O correspond to an apparent energy of 1.84 Mev, which is consistent with our knowledge of the γ spectrum.

*MDDC - 1694-KK Radiations from 3.7h La^{141}, by S. Katcoff, 5 p., n.d., decl. 2/16/48.

The 3.7h La^{141} was isolated from neutron-irradiated U. and a value of 2.8 Mev was determined for its maximum β energy. It was also shown that this isotope emits little or no hard γ radiations.

*MDDC - 1694-LL The Discovery of 14d Pr as a U Fission Product, by N.E. Ballou, 5 p., n.d., decl. 2/16/48.

Praseodymium has been found as a fission product of U. The isotope isolated decays with a half-life of 14d and has a maximum β energy of 1.0 Mev; no γ rays were detected.

*MDDC - 1694-MM Characteristics of the 13.8d Pr^{143}, by J.H. Goldstein, 4 p., n.d., decl. 2/16/48.

The 13.8d Pr is the daughter of the 33h Ce and has a mass of 143. It has a β radiation of 1.0 Mev maximum energy, but no γ radiation. The fission yield of the 13.8d Pr has not been determined, but the yield of the parent 33h Ce^{143} is 5.4 per cent.

*MDDC - 1694-NN Characteristics of the 28d Ce^{141}, by J.H. Goldstein, 5 p., n.d., decl. 2/16/48.

The 28d Ce has a mass of 141, a β radiation of 0.55 Mev energy and a γ radiation of 0.21 Mev energy. Its yield in U fission is 5.7 per cent relative to 6.1 per cent for 12.8d Ba^{140}.

*MDDC - 1694-OO The Characteristics of the 275d Ce^{144}, by J.H. Goldstein, 6 p., n.d., decl. 2/16/48.

The 275d Ce has a mass of 144 and decays to yield the 17.5m La. It has a β component of 0.348 Mev energy, but no γ component. The best value of the U^{235} fission yield is $\sim$ 5.3 per cent.

* MDDC - 1694-PP Further Work on the Long-Lived Ce-17.5m Pr Chain, by V.A. Nedzel, 3 p., n.d., decl. 2/16/48.

The entire report is given here.

The existence of the 17.5m daughter of the 300d Ce was checked by Burgus soon after the report of its discovery. His energy values for the β radiations were in agreement with those given below.

The chain was found in deuteron-induced fission by Overstreet and Jacobson who obtained a value of 18.2m for the half-life of the Pr daughter.

The radiations given off by the pair of activities have been examined in the 180° β-ray spectrometer. The β-ray spectra from the two isotopes were found to have end points at 0.348 and 3.07 Mev. It was obvious that the former was due to the parent Ce and the latter to the daughter Pr. The higher energy was in essential agreement with the value of 2.9 from adsorption measurements, while the lower one was substantially higher than the previous value of 0.25 Mev.

In addition, the β-ray spectrometer study showed the presence of three lines of conversion electrons of rather low intensity.

CONVERSION ELECTRONS

Energy, Kev	91.0	103.5	128.0
Relative Intensity	2.4	0.9	1.0
Intensity relative to β ray	0.0052	0.0022	0.0024

The difference between the energies of the first and third of these, 37 Kev, corresponds to the difference between the K and L binding energies for elements in this region of the periodic table. For Ce, Pr and Nd this difference is, respectively, 34.0, 35.2, and 36.4 Kev. Thus the observed difference would correspond most closely to that for Nd, which indicates that the γ ray giving rise to the electrons follows, or at least is connected with, the decay of the 17m Pr. However, the accuracy of the measurements is probably not sufficient to justify such a definite choice. The energy of the γ ray, if it originates in Nd, would be 91.0 + 43.5 = 134.5 Kev or 128.0 + 7.1 = 135.1 Kev.

The second conversion line cannot be identified as easily. If it originates in the K shell of Pr, the energy of the γ ray being converted would be 103 + 42.0 = 145 Mev.

*MDDC - 1694-QQ Absence of Long-Lived Daughters of Long-Lived Ce, by N.E. Ballou, 9 p., n.d., decl. 2/16/48.

Work reported here shows that several previously reported long-lived trans-cerium activities derived from Ce parents do not exist in pile fission material. The "55d Pr" was shown to correspond to 57d Y^{91} contamination; the "11d trans-cerium" activity, to 13.5d Pr^{143} contamination; and the "1y trans-cerium" activity, to the 275d Ce^{144} activity.

*MDDC - 1694-RR Discovery of a Long-Lived Rare-Earth Activity, by N.E. Ballou, 7p., n.d., decl. 2/16/48.

A long-lived rare-earth activity which follows La in La-Ce and La-Y separations has been found. The maximum energy of its β's is about 0.2 Mev, and its half-life has been determined to be $\sim$4y.

*MDDC - 1694-SS Study of the 25m $Sm^{(155)}$ in Fission, by L. Winsberg, 12 p., n.d., decl. 2/16/48.

The 25m Sm which can be produced by neutron and deuteron activation of Sm is formed in the fission of both U and Pu. The radiations of this isotope as determined by absorption measurements are a 1.9 Mev β and a 0.3 Mev γ. The fission yield in U^{235} is 0.031 per cent and in Pu^{239}, 0.21 per cent, providing strong evidence (based on the fission yield vs. mass curves) for the existence of the chain

$$25m\ Sm^{155} \rightarrow 2y\ Eu^{155} \rightarrow \text{stable } Gd^{155}$$

In addition, the β radiations of $\sim$ 10h $Sm^{(156)}$ are shown to have a top shelf half-thickness of $\sim$ 31 mg Al/cm^2, which corresponds to an energy of 0.9 Mev. The half-lives of the element 61 parents of 47h Sm^{153} and $\sim$ 10h $Sm^{(156)}$ are less than $\sim$ 5m.

*MDDC - 1694-TT Preliminary Study of the Fission Products of Th, by N.E. Ballou, et al., 11 p., n.d., decl. 2/16/48.

Preliminary experiments were performed to identify the fission products arising from the fast neutron fission of the Th. Modifications were made in the analytical procedures for the alkaline earths and rare earths because of contamination by the Th disintegration products and the chemical interference of Th. Fission products were isolated in the range of Se to Ce, and the same activities known from U fission were found. No quantitative work on the fission yield of the activities was done.

MDDC - 1695 High Frequency Vacuum Breakdown Tests for Copper and Copper Plated Ceramic Surfaces, by P.C. Bettler, 6 p., February 17, 1947. (BP-60).

Disposition as required for use in research, development, or manufacturing work.

The teeth of the rotary capacitor for the University of Rochester frequency modulated cyclotron are to be made of copper plated ceramic material. Tests were conducted on the high frequency breakdown in a vacuum between copper plated zircon surfaces. For comparison, solid copper electrodes were also tested. The gap electrodes were flat plates approximately 3/4" by 1 1/4" with 1/16" radius corners.

Data were obtained for both outgassed and fresh surfaces. It was found that the copper plated ceramic gave about the same results as solid copper. The sputtering of the copper plating is apparently not too serious. The design of the University of Rochester rotary capacitor is based on these tests and experience with the 184" rotary capacitor.

*MDDC - 1696 Some Observations on the Chemistry of Element 43 (Technetium), by G E. Boyd, Q.V. Larson, and E.E. Motta, 1 p., n.d., decl. 2/16/48.

For oral presentation before the Symposium of the American Chemical Society in April 1948, and for publication in an abstract bulletin of the American Chemical Society.

This paper is an abstract and the text is given here in full.

Milligram quantities of the 9 x 10^5 y radio-isotope of element 43 have been produced by prolonged neutron irradiation of pure molybdenum metal powder. After a suitable lapse of time to allow for the decay of the accompanying radioactive 67 h Mo^{99}, the element may be extracted from the molybdenum matrix by a volatility procedure in which only those precautions appropriate to low level activity operations are requisite. Yields on extraction have exceeded 90%. In order to isolate the element in greater than 90% purity, subsequent steps to remove Mo and particularly Re contamination were necessary.

Analytical procedures have been developed based on the coprecipitation of 43 with Pt and Re carriers followed by a measurement of the 0.3 Mev beta radiations with a mica end-window G.M. tube.

Observations on the behavior of 43 during the extraction and isolation procedures, together with special studies on its volatility, electrodeposition, exchange adsorption, solvent extraction, etc., have been found consistent with the probable occurrence of the IV, VI and VII valence states.

The presently known atomic, physical and chemical properties of element 43 will be summarized and compared with those of Mn, Mo, Ru and Re.

MDDC - 1697 Design Study for a Ten Bev Magnetic Accelerator, by W.M. Brobeck, 21 p., August 22, 1947. (BP-103).

For publication in the Review of Scientific Instruments.

A ten billion volt proton synchrotron design using injection from Van de Graaff generators and betatron starting to reduce the required oscillator frequency range is described. Factors affecting the design of the iron core magnet, its power supply and associated apparatus are discussed. Cost is roughly estimated as fifteen to twenty million dollars.

MDDC - 1698 The Effect of Roentgen Irradiation on Antibody Formation in Rabbits, by C.G. Craddock and J.S. Lawrence, 27 p., January 27, 1948. (M-2011).

For publication in the Journal of Immunology.

Exposure of rabbits to 250r whole body x-ray eight hours prior to immunization causes a greatly diminshed antibody response. This depressant effect is not permanent. Exposure of rabbits to the same amount of x-ray after antibody formation has begun, but before its completion, in no way impairs antibody formation. The degree of lymphopenia was comparable in each group. The "anamnestic phenomenon" could not be elicited in rabbits by x-ray exposure.

MDDC - 1699 Angular Correlation of Fission Neutrons, by S. DeBenedetti, J. E. Francis, W.M. Preston, and T.W. Bonner, 16 p., n.d., decl. 1/29/48.

For oral presentation at the January meeting of the American Physical Society held in New York City.

The abstract of this document has previously been issued as MDDC - 1530 and listed in this journal.

*MDDC - 1700 The Absorption Spectra of Transuranium Salts at Low Temperatures, by S. Freed and F. Leitz, 1 p., n.d., decl. 2/12/48. (ANL-JJK-14B-87).

For oral presentation at a symposium of the American Chemical Society to be held April 1948, and for publication in an abstract bulletin of the American Chemical Society.

This document is an abstract, and the entire text is presented here.

The absorption spectra of transuranium salts consists for the most part of lines comparable in sharpness with those of the rare earths. Their intensities, however, are considerably greater. The spectrum from crystals of one of the transuranium salts consisted mostly of lines from one to five angstroms wide, almost unique among crystals. The work was done with microgram quantities.

It appears, then, that analogies drawn between the transuranium elements and the rare earths go beyond the electronic configurations of the basic states, extending to the electronic configurations of the activated states also.

MDDC - 1701 Preparation of 1-C^{14}-Propene-1 and the Mechanism of Permanganate Oxidation of Propene, by B.A. Fries and M. Calvin, 18 p., December 10, 1947. (UCRL-19).

Publication in the Journal of the American Chemical Society.

The preparation of 1-C^{14}-propene-1 was undertaken in order to have available propene labelled in a terminal position and, incidently, to study the stability of the double bond when preparing propene under a variety of conditions.

The following three methods were actually employed for radioactive propene synthesis: (a) dehydration of n-propanol with metaphosphoric acid, (b) dehydration of n-propanol over heated alumina, and (c) pyrolysis of n-propyltrimethylammonium hydroxide.

Extensive rearrangement of the double bond was found to occur when preparing propene by dehydration with metaphosphoric acid and with heated Al_2O_3. However, the pyrolysis of the quaternary ammonium base gave little, if any, rearrangement and the product consisted principally of 1-C^{14}-propene-1 (CH_3-CH = CH_2).

The mechanism of the permanganate oxidation of the labelled propene was examined; it has been found to proceed by several paths, the relative importance of which depends upon the experimental conditions, especially the pH.

*MDDC - 1702 The Magnetic Susceptibilities of Some Uranium and Neptunium Compounds, by C.A. Hutchison, Jr. and N.S. Elliott, 1 p., January 1948. (ANL-JJK-14B-115).

For oral presentation at the Symposium of the American Chemical Society to be held in April 1948, and for publication in an abstract bulletin of the American Chemical Society.

This paper is an abstract. All of it is reproduced here.

The magnetic susceptibilities of some uranium and neptunium compounds have been studied over a wide temperature range. The magnetic moments calculated from these data give information as to the ground state electronic configurations of the ions involved. 5f orbitals are shown to be prominent in the ground states and certain similarities with the rare earths are established.

MDDC - 1703 The Potential of the U(V), U(VI) Couple and the Kinetics of U(V) Disproportionation in Perchlorate Media, by D.M.H. Kern and E.F. Orlemann, 25 p., December 26, 1947. (UCRL-27).

For publication in the Journal of the American Chemical Society.

Millimolar solutions of U(V) were prepared by electrolysis of uranyl ion in sodium perchlorate, perchloric acid solutions and studied by means of the dropping mercury electrode. The U(V), U(VI) couple has been shown to be reversible.

The diffusion coefficient of UO^+ is 0.86×10^{-5} cm^2/sec in 0.4 M $NaClO_4$; that of UO_2^{++} is 0.68×10^{-5} cm^2/sec in 0.09 M $NaClO_4$, 0.01 M $HClO_4$ at 25°C.

In 0.01 to 0.5 M perchloric acid the U(V) species is UO_2^+ as shown by the fact that the potential of the couple

$$UO_2^+ = UO_2^{++} + 1e$$

is constant at -0.066 ± 2 v at 25°C over this range of acidity in sodium perchlorate, perchloric acid solutions of ionic strength = 0.5.

In sodium perchlorate, perchloric acid mixtures of ionic strength 0.4 the disproportionation of UO_2^+ at 25°C obeys the following law from $a_{H^+} = 0.01$ to 0.4 and from $[UO_2^+] = 10^{-5}$ to 10^{-3} M.

$$\frac{-d[UO_2]}{dt} = k_2 \cdot a_{H^+} \cdot [UO_2^+]^2$$

where $k_2 = 130 \pm 4$ $(moles/1)^{-1}$, $(sec)^{-1}$.

The most probable mechanism for the disproportionation is:

$$UO_2^+ + H^+ = UOOH^{++}$$

$$UO_2^+ + UOOH^{++} \xrightarrow{k'_2} UO_2^{++} + UOOH^+ \text{ (slow step)}$$

$$UOOH^+ \longrightarrow \text{stable U(IV) species}$$

MDDC - 1704 Summary Report on Neutron Counter Work, by S.A. Korff, W.B. Spartz, and J.A. Simpson, 17 p., December 1, 1943. (A-1121 [CP]).

Disposition as required for use in research, development or manufacturing work.

A summary report with a discussion of the following divisions: (a) construction of instruments requested by the Chicago group, (b) a study of the plateau characteristics, especially the starting potential and plateau slopes of vapor-filled counters, (c) an investigation of some of the operating characteristics of neutron counters, (d) a study of the discharge mechanism in "fast" and "slow" counters, and development of a theory as to the mode of operation of the quenching agent in self-quenching counters, (e) measurements of the dead times and resolving times of counters with various fillings (f) the measurement of the charge collected on the wire of counters, and (g) the development of a new circuit, which reverses the potential of counters for the purpose of collecting the positive ions produced in the discharge and which promises to improve the speed of counting action by a factor of 10.

*MDDC - 1705 The Hydrolytic Behavior of Uranium and the Transuranic Elements, by K.A. Kraus and F. Nelson, 1 p., n.d., decl. 2/12/48. (ANL-JJK-14B-108).

For oral presentation at the Symposium of the American Chemical Society to be held in April 1948, and for publication in an abstract bulletin of the American Chemical Society.

This article is an abstract, and is presented here in full.

The hydrolytic behavior of uranium neptunium and plutonium is discussed on a comparative basis. The differences in behavior within the series for corresponding oxidation states are stressed, and the differences and similarities with other comparable ions are discussed.

MDDC - 1706 The Chemical Identification of Isotopes Formed in the Bombardment of Uranium with High Energy Particles, by P.R. O'Connor, 73 p., August 18, 1947. (BC-77).

Available as a dissertation for the Degree of Doctor of Philosophy.

Chapter I. A survey of the isotopes formed when uranium is bombarded with 200 Mev deuterons has been carried out for the elements higher than bismuth. The yield of the various isotopes is given in a table, with the yield of Ba^{140} taken as 1.0×10^{7}.

In most cases these isotopes seem to be formed by the ejection of many neutrons from the compound nucleus, followed by a series of rapid orbital electron capture processes until a relatively stable nucleus is reached. There is no evidence for the formation of shielded isotopes (except U^{237}) in this region but in many cases the half-lives of the isotopes are too long for detection.

Chapter II. A number of elements in the slow neutron fission region have been studied in order to obtain a rough yield curve with variation in mass of the isotopes. The relative yields are given in a table. Estimates of error in yield determination are given in the figure, due either to chemical losses or contamination from other isotopes.

In view of the high yields at the wings of the fission yield curve, it was apparent that isotopes below and above the fission region would probably be formed. The following elements were purified to investigate this: chromium, iron, nickel, and copper, below, and tungsten, osmium, and gold above the fission region.

It was found in all these cases that a small amount of activity was present after purification which could be assigned to known isotopes of these elements. In several cases it was possible to take crude absorption curves to aid in identification, but in most cases there was too small an amount of activity, which usually consisted of several components thus making absorption analysis difficult. The only isotopes which can be tentatively identified are beta emitters, all on the heavy mass side of stability. This suggests that the fission region has been extended considerably by bombardment with high energy particles.

Spectrographic analysis of the uranium metal showed iron was present as an impurity to the extent of 50-100 ppm. However, it is known from previous work that many reactions would occur on iron that would confuse the uranium picture quite badly. However, the fact that no positron emitting isotopes were observed (as expected from reactions on iron) seems to be fairly good evidence that the isotopes identified are formed from uranium.

Chapter III. Some prelimary results dealing with the yield of various isotopes formed in high energy deuteron bombardments of uranium, as a function of deuteron energy, are presented.

The excitation functions for the formation of the following isotopes are considered: AcX, ThX, At^{211}, and Ba^{140}.

MDDC - 1707 The Determination of Silica in Beryllium Metal Powder, by J.F. O'Leary, 4 p., January 31, 1947. (M-1950).

Disposition as required for use in research, development, or manufacturing work.

A procedure for the determination of silica in powdered beryllium samples is described and the rationale of the method is discussed.

The sample is weighed and dissolved in aqua regia, and the residue is fused with anhydrous sodium carbonate. The melt is dissolved in HCl, and the solution is added to the filtrate from the initial insoluble residue. The entire solution is evaporated to dryness, and the residue is taken up in HCl and water. The insoluble residue is washed with water and ignited to constant weight and then treated with a few drops of dilute H_2SO_4 and HF and ignited to constant weight. The loss in weight is the total silica in the sample.

MDDC - 1708 Electrolytic and Polarographic Determination of Zinc in Thorium, by J.H. Patterson and C.V. Banks, 13 p., n.d., decl. 2/4/48.

For publication in Analytical Chemistry or Analytica Chimica Acta.

Methods for the determination of zinc in thorium-zinc alloys ranging from 20 ppm to 100 per cent zinc are described. An electrolytic method is used for alloys that contain more than one per cent zinc. In this procedure the thorium is complexed with citrate so that it does not interfere with the deposition of zinc. For thorium containing less than one per cent zinc, a polarographic method is used. In this method the thorium is complexed with sulfosalicylate. The solution used contained 0.02 per cent gelatin to suppress the zinc maximum and had a pH of 8.5. In both electrolytic and polarographic methods nitrate interferes.

*MDDC - 1709 Preparation of Carrier-Free $Ac^{228}(MsTh_2)$ Tracer, by S. Peterson, 3 p., September 25, 1947. (ANL-JJK-14B-79).

To be included in the NNES(MPTS).

The McLane-Haissinsky actinium tracer preparation has been modified by substitution of cerium for lanthanum carrier. The cerium is then removed by oxidation with AgO and precipitation with HIO_3. Excess iodate is removed by ignition in platinum.

MDDC - 1710 The Higher Chlorides of Uranium, by C.H. Prescott, Jr., 8 p., December 1947. (ANL-JJK-14B-102).

For oral presentation at the Symposium of the American Chemical Society to be held in April 1948, and for publication in an abstract bulletin of the American Chemical Society.

Besides the valence state of 3 which uranium exhibits in common with other elements of the actinide and lanthanide series, the more common valence states of uranium are 4 and 6. With chlorine, UCl_3, UCl_4, UCl_5, and UCl_6 are formed.

UCl_4 is the most stable, while UCl_6 evolves Cl_2 starting slowly about 100°C. UCl_5 disproportionates in vacuo into UCl_4 and UCl_6 with volatilization of UCl_6 above 150°C. UCl_6, hitherto unknown, was discovered in attempts to purify UCl_5 by vacuum sublimation. All the chlorides are stable in dry air but hydrolyze upon access of moisture, UCl_6 being highly reactive.

Uranium oxides may be chlorinated with a variety of reagents, some in the vapor phase as described later. Liquid phase chlorination of UO_3, U_3O_8, or mixtures of UO_3 and UO_2 in 2:1 ratio yields the product UCl_5.

*MDDC - 1711 Comparison of Methods of Obtaining Surface Area of Crystalline Solids from Vapor Absorption Isotherms, by S. Ross, 1 p., n.d., decl. 2/16/48.

For oral presentation at a symposium of the American Chemical Society to be held in April 1948, and for publication in an abstract bulletin of the American Chemical Society.

This article is an abstract and the contents are given here in full.

Low temperature ethane adsorption isotherms on NaCl and KCl crystals, showing a first-order phase transition, are described in the monolayer region by two equations of the form $\pi(\sigma - \sigma_0) = i\,RT$, where σ_0 is the incompressible area per molecule for each of the two phases and i is an inverse function of the lateral molecular cohesion in each of the two phases. It is found that an agreement in the values for the specific surface of the solid with the specific surface obtained by the BET method can be obtained when σ_0 has a simple dependence on the underlying crystal lattice and the state of the adsorbed monolayer. The nature of this dependence is illustrated for the isotherms in question. The relation between the values of σ_0 thus deduced and the cross-sectional area required for use with the BET method is pointed out. A comparison of results obtained for specific surface, by various ways that have been proposed for treating vapor adsorption data, is included and the significance of the findings discussed.

*MDDC - 1712 Equilibrium in the Vapor Phase Hydrolysis of $PuBr_3$, by I. Sheft and N.R. Davidson, 17 p., September 1946. (ANL-JJK-14B-76).

To be included in the NNES(MPTS).

Equilibrium constants in the temperature range 540°C to 640°C were measured for the reaction

$$PuOBr + 2HBr \rightleftharpoons PuBr_3 + H_2O$$

by determining the pressure of H_2O vapor in equilibrium with a known pressure of HBr over a mixture of PuOBr and $PuBr_3$. The data have been used to derive the linear free energy equation:

$$\Delta F_{kcal} = -(22.8 \equiv 0.4) + (33.2 \pm 0.4)T/1000$$

By analogy with other substances, ΔC_p for the reaction has been estimated as +2.4 cal/deg mole, implying that $\Delta H_{298} = -24.1$ kcal, $\Delta S_{298} = 35.7$ e.u.

*MDDC - 1713 Equilibrium in the Vapor Phase Hydrolysis of $PuCl_3$, by I. Sheft and N.R. Davidson, 10 p., September 1946. (ANL-JJK-14B-77).

To be included in the NNES(MPTS).

Equilibrium constants in the temperature range 540°C-700°C were measured for the reaction:

$$PuOCl + 2HCl = PuCl_3 + H_2O$$

by determining the pressure of H_2O vapor in equilibrium with a known pressure of HCl over a mixture of PuOCl and $PuCl_3$. The data were used to derive the equation:

$$\log_{10}K(atm^{-1}) = \frac{4555 \pm 160}{T} - (6.757 \pm 0.180)$$

implying that, in the temperature range of the measurements:
ΔH(kcal) = -20.8 ± 0.7, ΔS(e.u.) = -30.9 ± 0.8. It is estimated that $\Delta H_{298°}$ (kcal) = -22.2 ± 0.7, $\Delta S_{298°}$ (e.u.) = -33.5 ± 0.8.

It was observed that equilibrium was much less readily obtained in this reaction than in the corresponding bromide reaction.

MDDC - 1714 Determination of p-Toluenesulfonamide, by J. Sirota, 4 p., n.d., decl. 1/30/48.

For publication in a scientific journal.

Analysis of p-toluenesulfonamide in nickel plating baths is made by chlorination of the compound, solution of the reaction product in excess KI solution and titration of the liberated iodine with standard thiosulfate in the usual manner. The method has specific advantages for the plating industry, is fairly rapid and more accurate than others now in use.

MDDC - 1715 The Toxicity of Hexachlorpropylene and Trichloracrylyl Chloride, by C.J. Spiegl, R.E. Howe, and L. LaFrance, 26 p., July 1947. (M-2005).

Disposition as required for use in research, development, or manufacturing work.

A total of approximately 180 rats, 175 mice, and 50 rabbits were exposed in groups comprising 10 rats, 10 mice and 3 rabbits for 30-minute periods to a series of atmospheric concentrations of hexachlorpropylene (HCP) and trichloracrylyl chloride (TCAC). The LD_{50} for rats was statistically evaluated by the method of Bliss and found to be 425 ppm for HCP and 107 ppm for TCAC. Death from TCAC occurred within 4 days of exposure; death from HCP lingered into the 14th day.

Histologic sections made of the lung and liver showed an intensity of pulmonary damage ranging from neutrophil accumulation to severe pneumonia and, in addition, hepatic necrosis in one-third of the animals exposed to HCP. In the animals exposed to TCAC, the lung was the principal site of damage; this consisted of congestion, hemorrhage, atelectasis and occasional pneumonia.

The nature and extent of the toxicity of HCP were also investigated in a series of intraperitoneal and subcutaneous injections in rats. Liver necrosis in the peripheral or periportal cells was consistently found in these animals; this condition was most prominent at 48 hours after injection but was uniformly absent at the end of two weeks. Occasional transient renal tubular necrosis with some consequent elevation of blood NPN was also observed. Subcutaneously, 0.3 ml of HCP produced skin and muscle necrosis to an extreme degree.

Skin and eye irritation was studied by direct application of the compounds to suitable areas on rabbits. HCP and TCAC were 10 to 20 times more irritating to clipped rabbit skin, respectively, than was CCl_4; as little as 0.0005 ml of HCP or 0.00027 ml of TCAC produced erythema. In the eye, HCP and CCL_4 gave approximately the same effect. TCAC, however, produced erythema in the eye with as little as 5 seconds of exposure to 0.00256 ml of the compound.

*MDDC - 1716 Introductory Remarks, by J.A. Swartout, 1 p., n.d., decl. 2/16/48.

For oral presentation before a symposium of the American Chemical Society to be held in April 1948, and for publication in an abstract bulletin of the American Chemical Society.

The article is an abstract and is presented here in full.

Prior to the advent of the uranium pile nearly all radiochemical research was conducted in standard chemical laboratories. The small amounts of radioisotopes from natural sources or high energy accelerators constituted minor radiation hazards. In contrast, the uranium pile made possible the production of the relatively large amounts of radioisotopes which are now being distributed to research institutions.

Because of the urgency of the research program for the production of fissionable material it was necessary during the war to utilize existing laboratories or temporary structures. Modification of these facilities was resorted to as high intensity sources became available for research. The research centers of the Atomic Energy Commission are now undertaking programs for replacing the temporary chemical laboratories with permanent laboratories designed specifically for radiochemical work. In addition, other institutions engaged in research with radioisotopes distributed from Oak Ridge are becoming concerned with the design of such laboratories. Because few radiochemical laboratories have yet been constructed, the designs and concepts to be presented in the Symposium are, in many cases, preliminary and untested. However, in general, they are based upon extensive and varied radiochemical research with a wide range of levles of radioactivity.

*MDDC - 1717 Design of Radiochemistry Laboratories for Research with Low Levels of Radioactivity, by J.A. Swartout, 1 p., n.d., decl. 2/16/48.

For oral presentation before a symposium of the American Chemical Society to be held in April 1948, and for publication in an abstract bulletin of the American Chemical Society.

This paper is an abstract, and the entire contents are given here.

The majority of radiochemical research is performed with quantities of beta and gamma ray emitting radioisotopes ranging from tracer or microcurie levels up to a few millicuries. Although the handling, in these amounts, of radioisotopes having weak radiations requires few unique laboratory features, a laboratory designed for general radiochemical research should be equally capable of accommodating work with hard beta and gamma emitting isotopes. Therefore, provisions are required for local shielding for the prevention of the spread of radioactive contamination and for decontamination.

General features to be considered in the design of such a laboratory include: the application of the modular principle which has been used successfully for standard chemical laboratories; arrangement of associated offices, "semi-hot" laboratories, and rooms for instruments and decontamination facilities; distribution of utilities and ventilation ducts; and waste disposal and drains for chemical and radioactive wastes.

Specific design problems include: the type of laboratory hoods; arrangement of the laboratory; design of furniture; provision for monitoring instruments; method of lighting; suitable, easily decontaminable materials for floors, walls and bench tops; and provision for local shielding of active samples and for storage vaults for active stock solutions.

* MDDC - 1718 The Tracer Chemistry of Americium and Curium, by S.G. Tompson, R.A. James, and L.O. Morgan, 1 p., December 1947. (ANL-JJK-14B-84).

For oral presentation before the Symposium of the American Chemical Society in April 1948, and for publication in an abstract bulletin of the American Chemical Society.

This document is an abstract and the entire contents are given here.

Investigation of the chemical properties of elements 95 (americium, Am) and 96 (curium, Cm) by means of tracer techniques has led to the following conclusions. In aqueous solutions, both elements exist predominantly in the tripositive oxidation state and exhibit a high degree of similarity to the tripositive rare earth elements, particularly those in the range of atomic numbers 60-63. (By taking advantage of small differences in chemical properties, three methods for the separation of americium and curium from the rare earth elements have been devised.) Evidence for the oxidation and reduction of Am(III) is obtained only through the use of the most powerful oxidizing and reducing agents and even these are ineffective in the case of Cm(III). In general, the results of these studies support the view that americium and curium are members of an "actinide series" of elements related to actinium in the same sense that the rare earth elements are related to lanthanum.

* MDDC - 1719 Influence of Radioactivity on Chemical Laboratory Technique and Design, by P.C. Tompkins and H.A. Levy, 1 p., n.d., decl Feb. 2, 1948.

For oral presentation before the American Chemical Society symposium to be held in April 1948.

This paper is an abstract and is given here in its entirety.

The radiative properties of radioactive substances are independent of their chemical properties and impose additional requirements on chemical laboratory design and practice. A general philosophy is developed through which problems associated with the handling of radioactive materials may be successfully attacked. An attempt is made to establish a basis on which to build satisfactory standards of practice, and to evaluate the resulting impact on the facilities for implementing them. In particular, the segregation of areas of work is discussed, and types of facility appropriate to each.

Problems of ventilation, accumulation of activity, and material control are examined in the light of these considerations. The selection of laboratory furniture, surface materials, floors, and shielding is discussed.

*MDDC - 1720 Pile Neutron Physics. by A.M. Weinberg, 15 p., January 1947.

For use in lectures and seminars.

It is assumed that the Boltzman equation may be written as an integral equation whenever the scattering and the source are isotropic. With reference to an integral equation in a previous work by integrating over μ, an integral equation is obtained in $F_0(x,v)$. The total number of neutrons which start fresh flights per second in each cubic centimeter is expressed; this quantity may be viewed as the source which furnishes neutrons for the remainder of the medium. An integral equation may be written. In this form the integral equation of isotropic transport theory resembles very much the integral equation (previously referred to) of diffusion theory. The plane transport kernel and the plane diffusion kernel are expressed and the relationship shown by a formula. It is shown that the transport kernels in the other geometries can be obtained similarly from the diffusion kernels. The results are tabulated for the geometries: point, plane, spherical shell, line, and cylindrical shell, respectively. The equivalence between a spherical shell and a point, or a cylindrical shell and a line, which hold for the diffusion and the potential kernels does not hold for the transport kernels. The discussion is continued based on the introduction of a thin foil into an infinite medium in which monoenergetic neutrons are being produced everywhere at a constant rate.

Solution of the steady state diffusion equation in various geometries and measurement of diffusion length is considered. A few examples of the calculation of the thermal neutron distribution in systems of particular shape and with certain source distributions are given.

The non-stationary neutron diffusion problem from the elementary standpoint is next considered (previously the neutron density was considered to be independent of time and only the stationary spatial and angular distributions were sought). Time-dependent diffusion kernels are tabulated according to the geometries previously mentioned.

Propagation of neutron waves is discussed on the assumption that instead of an instantaneous source of monoenergetic neutrons at $x = 0$, there is a localized source whose intensity oscillates with a given angular frequency. The analogy between the propagation of neutron waves and the propagation of heat waves is developed and experiments analogous to the angstrom method for measuring thermal conductivity are suggested.

* MDDC - 1721 Fluorescence Spectra of Uranyl Compounds, by J. Bigeleisen and M. G. Mayer, 1 p., January 1948. (ANL-JJK-14B-107).

For oral presentation at the American Chemical Society Symposium to be held April 1948, and for publication in an abstract bulletin of the American Chemical Society.

The entire original abstract is presented here.

The pioneer work of Nichols and Howe on the fluorescence of the uranyl salts has been extended by the spectroscopic group at the SAM Laboratories and Johns Hopkins University of the Manhattan Project. Measurements have been made with single crystals and powders between #20°K and 300°K with spectrographs of low and high resolution. The fluorescence of one salt differs from another. While the spectrum is due to an electronic transition in the uranyl ion, the vibrations of the uranyl ion and the lattice are excited. The anion in the lattice primarily determines the intricate structure of the fluorescence. An analysis of the strong lines in the fluorescence, based on the vibrations of uranyl ion will be given. The analysis is supported by studies with enriched O^{18} and U^{235}.

* MDDC - 1722 The Thermodynamics of the Actinides, by L. Brewer, 1 p., December 1947. (ANL-JJK-14B-95)

For oral presentation at the American Chemical Society Symposium to be held in April 1948, and for publication in an abstract bulletin of the American Chemical Society.

The entire original abstract is presented here.

The available thermodynamic data for the various oxidation states of thorium, uranium, neptunium, and plutonium have been recently compiled by Brewer, Bromley, Lofgren, and Gilles in declassified Atomic Energy Commission Papers. The data have been converted to a form which allows direct comparison of the stabilities of the various oxidation states of the actinides. The heats of formation of the higher oxidation states from the trivalent state vary regularly through the actinide series. The heats of formation from the metal show alternations which indicate that the properties of the metals do not vary uniformly.

The thermodynamic data are also used to predict which oxidation states of the various halides of Th, U, Np, and Pu should be stable and preparable.

* MDDC - 1723 The Formation of Be^{10}, by C. Eggler, D. J. Hughes, and C. Huddleston, 1 p., January 12, 1948. (ANL-HDY-400).

For oral presentation at the American Physical Society meeting to be held in Washington, D. C., April 20 to May 1, 1948, and for publication in the Bulletin of the American Physical Society.

The entire original abstract is presented here.

The radioisotope Be^{10} is of great interest because its half-life is extremely long in spite of the expected allowed nature of its disintegration. As part of a program of study of this activity we have investigated methods of making Be^{10} in the pile. The formation of Be^{10} by the (n,γ) and the (n,α) reactions has already been reported. Because of the small yields of these reactions it was decided to investigate the (n,p) as well. Although the latter is slightly exothermic the penetrability of the proton and the self protection of the sample for slow neutrons will make the formation of Be^{10} by the thermal neutrons extremely small. The main source of Be^{10} was expected to be the fast neutrons so some amorphous boron was irradiated near the uranium lumps in the Hanford pile. Beryllium carrier was added to the boron and then separated using the basic acetate process. The final beryllium showed an activity which did not decay and had the correct absorption curve for Be^{10}. The specific activity obtained gives a cross-section for fast pile neutrons of 3 millibarns and shows no appreciable contribution from thermal neutrons.

MDDC - 1724 Physical Properties of Chlorotrifluoroethylene Polymers as a Function of Molecular Weight. II. Molecular Fractionation, Density, Viscosity, Molecular Weight and the Correlation of These Properties of Chlorotrifluoroethylene Polymers, by J. L. Gabbard, et al., 36 p., January 15, 1948. (K-124).

For publication in the Journal of the American Chemical Society.

A number of randomly selected samples from different lots of chlorotrifluoroethylene polymer were separated by the use of falling-film type molecular stills into fractions with molecular weights ranging from approximately 400 to 1300. Family trees of each sample, showing its physical properties, are presented.

The densities, viscosities, and molecular weights of the various fractions were determined with a high degree of accuracy. These data are presented and are correlated graphically.

Empirical equations were derived which accurately express the relationships between density and molecular weight, viscosity and molecular weight, and viscosity and density of the respective fractions. The deviations of the calculated from the observed values for a number of randomly selected fractions are shown in tables.

* MDDC - 1725 The β-Spectrum of Be^{10}, by D. J. Hughes and C. Eggler, 1 p., January 12, 1948.

For oral presentation at the American Physical Society meeting to be held in Washington, D. C., April 20 to May 1, 1948, and for publication in the Bulletin of the American Physical Society.

The entire original abstract is given here.

The disintegration of Be^{10} is expected to be allowed on the basis of spin difference and of comparison with the mirror nucleus C^{10}. However, its half-life of about 3×10^6 years indicates a highly forbidden disintegration. It is, therefore, of interest to determine if the β distribution is of an allowed or a highly forbidden shape. Because of the great half-life and low cross-section for the formation of Be^{10} (See MDDC-1723) it seems likely that material will not be available for a spectrometer determination of the spectrum for some time. The spectrum, is being measured,therefore, by comparison with "standard" spectra, which can be measured accurately in the spectrometer. The comparison is made both by means of the shape of μ absorption curves and by observing the β energy distributions in a helium filled cloud chamber. Assumption of a linear decrease of intensity with absorber thickness allows a simple conversion from absorption curve to spectrum shape, and study of standard spectra (W^{185}, Au^{198}, P^{32}, Cu^{64}) shows good correlation with their known β distributions. The β spectrum of Be^{10} given by the absorption method is found to have the allowed shape within experimental error.

* MDDC - 1726 Oscillatory Method for Measuring Neutron Cross-Sections by the Effect on the Reactivity of a Chain-Reacting Pile, by A. Langsdorf, Jr., 1 p., January 19, 1948. (ANL-HDY-405).

For oral presentation at the American Physical Society meeting to be held in Washington, D. C., April 20 to May 1, 1948, and for publication in the Bulletin of the American Physical Society.

The entire original abstract is presented here.

An increase in sensitivity by a factor of about 20 over the already described static control rod method has been achieved by oscillating samples in and out of the Argonne heavy water pile (at one cycle per 20 seconds). The a.c. ripple in ion current from a BF_3 chamber in the pile is measured by a galvanometer circuit. Emphasis has been placed upon measuring resonance absorption, $\int \sigma_a dE/E$, of samples oscillating in a cadmium tube. One then measures capture, slowing-down and scattering effects. The scattering may almost be eliminated, slowing down calculated, and $\int \sigma_a dE/E$ determined except for some light elements. Total pile cross-sections are measured by removing the Cd sleeve. Then absorption as small as by Bi ($\sim 0.05 \times 10^{-24}$ cm^2 including impurities) may be measured to a few per cent in spite of 200 times greater σ_s, using a 1000 gm sample.

• MDDC - 1727 Absorption Spectra of Some Uranyl Salts, by M. G. Mayer and J. Bigeleisen, 1 p., January 1948. (ANL-JJK-14B-106).

For oral presentation at the American Chemical Society Symposium to be held in April 1948, and for publication in an abstract bulletin of the American Chemical Society.

This paper is an abstract and is presented here in its entirety.

The absorption measurements on single crystals of the uranyl salts by the spectroscopic group at the SAM Laboratories and Johns Hopkins University of the Manhattan Project will be discussed. The absorption spectra are much more complicated than the corresponding fluorescence spectra. Whereas all of the fluorescence lines originate from transitions from the lowest level in the excited state (except where anti-Stokes lines are involved) to various levels in the ground state, in absorption there are transitions from the ground state to each of the four discrete electronic states which lie between 20,000 and 28,000 cm^{-1} above the ground state. Superimposed on the electronic transition are vibrations of the uranyl ion and the lattice. The structure of the absorption spectra will be discussed with the aid of results obtained by using enriched isotopes.

• MDDC - 1728 Management and Treatment of Exposed Personnel, by J. E. Wirth, 17 p., January 1947. (CH-3761).

To be included in the NNES(MPTS).

In any discussion of the management or treatment of personnel who have received an over-tolerance exposure to radiation, one must recognize immediately that the present armamentarium is woefully lacking. It is important to realize that once a person has been irradiated, there is no known means of reversing the biological processes set in motion by this irradiation. Treatment, therefore, can be symptomatic only. The main objective must be prophylaxis which can, and must, be attained by preventing exposures to quantities which may be harmful.

The report discusses the following topics: high pocket or badge meter readings, exposure analysis, contaminated skin, personnel with open skin lesions, wounds with contaminated material, and inhalation or ingestion.

MDDC - 1729 Vapor Phase Chlorination of Uranium Oxides, by H. G. Reiber and H. A. Young, 7 p., December 1947. (ANL-JJK-14B-103).

For oral presentation at the American Chemical Society Symposium to be held in April 1948.

Uranium oxides or oxychlorides may be chlorinated with a variety of reagents such as CCl_4, S_2Cl_2, $SOCl_2$, and even $MoCl_5$. Between 400°C and 500°C, CCl_4 vapor (often with a sweep gas such as CO_2) will chlorinate UO_2, UO_3, U_3O_8, UO_2Cl_2, and $U(C_2O_4)_2$. With UO_2 the reaction is: $UO_2 + CCl_4 = UCl_4 + CO_2$, the UCl_4 remaining as residue. Small amounts of $COCl_2$, UCl_5, and Cl_2 are formed. Higher oxides give more UCl_5. The CCl_4 cracks slightly to $C_2Cl_6 + Cl_2$.

Vapor phase chlorination with $CCl_4 + Cl_2$ or direct chlorination of UCl_4 yields UCl_5 as a sublimate, or mixed chlorides with as much chlorine as $UCl_{5.5}$. Vacuum sublimation of this product yields UCl_6.

* MDDC - 1730 Exchange Reactions of Uranium Ions in Solution, by E. Rona, 1 p., January 1948. (ANL-JJK-14B-117).

For oral presentation at the American Chemical Society Symposium to be held in April 1948.

This document is an abstract and is presented here in its entirety.

Exchange between U(IV) and U(VI) ions in aqueous solution was studied with U^{233} as tracer. The systems investigated were UCl_4-UO_2Cl_2, $UOCl_2$-UO_2Cl_2, and U(IV) carbonate - U(VI) carbonate. The rate of the UCl_4-UO_2Cl_2 exchange was measured at a variety of temperatures and concentrations. The reaction is of the second order with a heat of activation of 41.7 kcal/mole. The influence of pH was also studied. Exchange in the $UOCl_2$-UO_2Cl_2 system is significantly faster and is also of second order. The U(IV) carbonate - U(VI) carbonate system has been studied in a preliminary way and is also of second order.

Present results indicate that exchange between a non-oxygenated uranium and an oxygenated uranium is slower than between two oxygenated uranium atoms in different oxidation states.

Preliminary results on neptunium will be presented.

* MDDC - 1731 Control Exposure Chamber Studies, by G. F. Sprague, Jr., 50 p., January 1948. (M-2006).

To be included in the NNES(MPTS).

Data have been collected and evaluated on 12 dogs, 194 rats, 31 rabbits, and 30 guinea pigs serving as controls for twelve uranium dust exposure studies performed at extremely low concentrations of uranium for a period of one year.

The results of more than 31,000 separate observations have been summarized and have included chamber control data of nuisance dust concentration, temperature, humidity, mortality, weight response, histologic findings, biochemical changes, dental changes, hematology, and analysis of animal tissues.

Most arresting was the incidental observation that a conditioning period of approximately four months is indicated before animals come into equilibrium with the conditions imposed by daily exposure as judged from a study of weight records and biochemical changes.

Evidence from these studies indicates the dog was the species most consistently normal in biochemical response and from a histologic standpoint of any species studied. The dog was, therefore, considered to be best suited for use in uranium dust inhalation studies.

MDDC - 1732 Effect of Electron Beams on Aqueous Dichromate Solutions, by L. H. Treiman, 4 p., December 1947.

Disposition as required for use in research, development, or manufacturing work.

Solutions of $K_2Cr_2O_7$ were reduced under electron bombardment. In air-saturated solution, 0.1 N in $K_2Cr_2O_7$ and in H_2SO_4, 0.5 molecules of $K_2Cr_2O_7$ were reduced per 100 ev input. A $K_2Cr_2O_7$ solution of the same concentration but with no acid added was reduced at a rate which not only was smaller but also decreased with increasing exposure. This effect was probably caused by the increase of alkalinity attendant on reduction. In both aerated and deoxygenated 10^{-3} N $K_2Cr_2O_7$ solutions, 0.05 molecules of $K_2Cr_2O_7$ were reduced per 100 ev input.

MDDC - 1733 The Fluorescence of Uranium Trioxide Hydrates, by D. T. Vier, M. L. Schultz, and J. Bigeleisen, 11 p., December 21, 1944. (A-2176).

For publication in the Journal of the Franklin Institute.

The hydrates of uranium trioxide have been found to be fluorescent when exposed to ultraviolet light. The fluorescence spectra of the different hydrates have been measured. The anhydrous oxides do not fluoresce.

The three tables given are entitled as follows: X-ray classification, appearance of fluorescence spectra of the hydrates, and wave number tabulation of the fluorescence spectra of uranium trioxide hydrates.

• MDDC - 1734 Metabolic Studies on a Solution of Purified Human Albumin Given Intravenously to Man, by C. Waterhouse, K. Cusson, and S. H. Bassett, 1 p., n. d., decl. 2/17/48.

For publication in the Bulletin of the American Society for Clinical Investigation.

This paper is an abstract and is presented here in its entirety.

Metabolic balances were carried out on 3 protein depleted subjects, each of whom received purified human serum albumin as a protein supplement in the amount of 60 grams daily I. V. for 10-15 days. The effect of the procedure was evaluated by studying the nitrogen, calcium, phosphorus, and potassium balances as well as changes in serum proteins, plasma volume and kidney function.

All subjects showed practically quantitative retention of the injected protein for the first 5 days. Thereafter the nitrogen excretion tended to rise slowly, showing that some of the injected protein was being catabolized. The phosphorus balances became positive which strongly suggests that a fraction of the injected ablumin was being converted into some other form of protein. Two of the subjects were in negative calcium balance and it is, therefore, clear that phosphorus was not being stored with calcium.

Serum albumin levels rose during albumin administration, maximum levels being 5.7, 5.8, and 6.1 in the 3 patients. The rising level of serum protein was accompanied by an expansion of the plasma volume of approximately 25% and a sharp rise in body weight which in one subject exceeded 5 kg.

(Cont'd on next page)

• MDDC - 1734 Metabolic Studies on a Solution of Purified Human Albumin Given Intravenously to Man, by C. Waterhouse, K. Cusson, and S.H. Bassett, 1 p., n. d., decl. 2/17/48. (Cont'd from page 170).

Before cessation of the ablumin supplement all patients developed proteinuria. However, the degree was variable ranging from a maximum of 3 gm a day in one patient to 30 gm a day in another.

Kidney function studies done on one patient showed (1) a significant increase in filtration rate and renal plasma flow during albumin therapy, (2) no change in renal blood flow, and (3) no change in filtration fraction.

• MDDC - 1735 Total Neutron Cross-Sections of Compounds with Different Crystalline Structures, by L. Winsberg, D. Meneghetti, and S. S. Sidhu, 1 p., January 12, 1948. (ANL-HDY-401).

For oral presentation at the American Physical Society meeting in Washington, D. C., April 20 to May 1, 1948, and for publication in the Bulletin of the American Physical Society.

This paper is an abstract and the entire contents are given here.

The total neutron cross-sections of polycrystalline compounds such as close-packed hexagonal ZnO, body-centered cubic TlBr, and face-centered cubic CaO were determined with the Argonne neutron velocity selector and neutron crystal spectrometer in the energy region of 0.001 to 1.0 electron volts. The curves of cross-section as a function of neutron energy were resolved as a sum of absorption, coherent scattering and incoherent scattering cross-sections. These curves contain cross-section peaks which are due to coherent scattering from various crystalline planes. The positions of the peaks come at neutron wave lengths which satisfy the relation, $n\lambda = 2d$, where n is the order of the reflection and d is the interplanar distance. These diffraction effects are similar to those obtained with X-rays. The cross-sections calculated were compared with the experimentally obtained curves. The change in the phase of the neutron wave on scattering by Zn and Ca is the same as that for O, which is in agreement with the work of Fermi and Marshall, and for Tl is the same as for Br. The free-atom scattering cross-section of Ca determined from these data is 2.5 ± 0.5 barns, based on a value of 4.1 barns for O. The corresponding scattering amplitude for Ca is $0.46 \pm 0.05 \times 10^{-12}$ cm^2. These values for Ca are much less than any previously reported.

*MDDC - 1736 Studies on the Mechanism of the Propionic Acid Fermentation, by S.F. Carson, et al., 1 p., n.d., decl. 2/18/48.

For publication in connection with the May meeting of the Society of the American Bacteriologists.

This paper is an abstract and all of it is reproduced here.

The mechanism of formation of propionic, acetic and succinic acids by Propioni-bacterium pentosaceum is under investigation. With the use of C^{14}-labelled bicarbonate and carboxyl-labelled acetate, intermediate substances between pyruvate and propionate have been isolated, but as yet are not pure enough to be identified. From the studies on succinate formation it seems evident that this end-product arises by at least two independent paths: from CO_2 plus a three-carbon intermediate, and as well by the Thunberg-Wieland Scheme of acetate condensation; the extent of each depends almost entirely upon the redox state of the fermentation, and this can be altered.

*MDDC - 1737 Oxides of Transuranium Elements, by D.M. Gruen and J.J. Katz, 1p., January 1948. (ANL-JJK-14B-113).

For oral presentation at the American Chemical Society Symposium to be held in April 1948, and for publication in an abstract bulletin of the American Chemical Society.

The complete text of the report is reproduced herewith.

The reaction of NO_2 on NpO_2 has been employed in the preparation of a higher oxide of neptunium, Np_3O_8. This compound was identified both crystallographically and analytically by means of thermal decomposition data obtained on 2.5 mgm of the oxide in a micro gas apparatus. The thermal stabilities of UO_3 and Np_3O_8 are roughly comparable.

Experiments with atomic oxygen indicate that NO_2 oxidations may proceed through an atomic oxygen mechanism. Evidence for this is discussed.

Extension of NO_2 and atomic oxygen reactions to the preparation of higher oxides of Np, Pu, Pr, Nd, and Tb are discussed.

• MDDC - 1738 **The Isolation of Actinium and Preparation of Some of Its Compounds, by F. Hageman, 1 p., December 1947. (ANL-JJK-14B-99).**

For oral presentation at the American Chemical Society Symposium to be held in April 1948, and for publication in an abstract bulletin of the American Chemical Society.

The complete text of the report is reproduced herewith.

Three-fourths of a milligram of actinium was produced by irradiation of one gram of radium with pile neutrons through the reactions

$$Ra^{226}(n,\gamma)Ra^{227} \quad \underset{\text{(short)}}{\beta^-} \quad Ac^{227}$$

The actinium was isolated in an essentially pure state by a procedure involving extraction with thenoyltrifluoracetone. A number of actinium compounds were prepared on a 10 microgram scale and identified by X-ray diffraction methods.

MDDC - 1739 **The Relation of Backscattering to Self-Absorption, by P.E. Yankwich and J. Weigl, 10 p., January 12, 1948. (UCRL-34).**

For publication in the Physical Review.

The effects of backscattering upon self-absorption correction curves are demonstrated. Data are given for the backscattering powers of several substances for the beta radiation from C^{14}, and for self-absorption of samples of barium carbonate and wax, containing C^{14}, mounted on aluminum. A more refined treatment of the problem is being worked on.

MDDC - 1740 **The Isotopic Constitution of Praseodymium and Neodymium, by M. G. Inghram D. C. Hess, Jr., and R. J. Hayden, 3 p., January 2, 1948. (ANL-AJD-224).**

For publication as a Letter to the Editor of the Physical Review.

Mass spectrometric measurements of the isotopic constitution of praseodymium and neodymium are reported. Upper limits are set for the existence of some of the rare isotopes. The results for neodymium are compared with those previously obtained by Mattauch and Hauk on the basis of photometric analysis of photographic plates.

Isotopic Constitution of Neodymium

Observer	142	143	144	145	146	148	150
Mattauch & Hauk	25.95	13.0	22.6	9.2	16.5	6.8	5.95
This work	27.27	12.26	23.95	8.27	17.06	5.66	5.53
	± 0.3	± 0.1	± 0.2	± 0.1	± 0.2	± 0.06	± 0.06

* MDDC - 1741 **Chemical and Physical Properties of Uranium Peroxide, by C. E. Larson, 1 p., January 1948. (ANL-JJK-14B-112).**

For oral presentation before the American Chemical Society Symposium to be held in April 1948, and for publication in an abstract bulletin of the American Chemical Society.

This article is an abstract and is presented here in its entirety.

The precipitation of uranium peroxide from acidic uranyl solutions is one of the most specific and useful reactions of uranium.

Because the solubility of uranium peroxide is intermediate between such insoluble compounds as ferric hydroxide, and comparatively soluble compounds such as magnesium sulfate, careful attention must be paid to the conditions of precipitation if a reasonable degree of quantitativeness is to be obtained. For this reason an intensive study of the equilibria and kinetics of the precipitation reaction has been made.

In pure solutions the equilibrium constant for the reaction

$$UO_2^{++} + H_2O_2 \rightleftharpoons UO_4 \times H_2O + 2H^+$$

was found to be 6.7×10^2. The effect of cations and anions on precipitation was systematically investigated.

The most effective inhibitors were sulfate and fluoride ion among the anions and alkali and alkaline earths among the cations.

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•MDDC - 1741 **Chemical and Physical Properties of Uranium Peroxide, by C. E. Larson, 1 p., January 1948. (ANL-JJK-14B-112).** **(Cont'd from page 174).**

The specific effect of ferric ion in catalytically decomposing peroxides was investigated and methods found for minimizing its effect.

Conditions of precipitation were found to have a profound effect on subsequent surface characteristics of the dried product. The physical and chemical properties of the solid uranium peroxide are summarized.

•MDDC - 1742 **Preparation of Radioactively Pure Ac^{228}($MsTh_2$), by C. K. McLane and S. Peterson, 4 p., September 1947. (ANL-JJK-14B-80).**

To be included in the NNES(MPTS).

An improved and rapid method has been found to prepare Ac^{228} of better than 99.95% radioactive purity.

Since the immediate decay product of Ac^{228}, 1.9 y Th^{228}(RdTh) has a relatively long half-life, samples of Ac^{228} tracer can be corrected for decay by the simple exponential law. The half-life, of Ac^{228}, 6.13 hr, is long enough to be satisfactory for experiments requiring less than one day. The activity can be obtained by separation from its parent, 6.7 y Ra^{228}($MsTh_1$), immediately before use. For preparation of radioactively pure tracer, separation must also be made from the daughters Th^{228}, Ra^{224}(ThX), Pb^{212}(ThB), and Bi^{212}(ThC). The method described is a modification of that used by Haissinsky.

The chemistry involved in the process is identical with that used by Haissinsky except for the addition of Pb^{++} and Th to the starting solution. However, by substitution of centrifugation for the filteration used in the original method, the operations can be carried out more quickly and with the use of less inactive carrier for the tracer quantities of the radioactive isotopes. Except for the final evaporation and ignition, all operations can be speedily and efficiently carried out in 15 ml centrifuge cones.

*MDDC - 1743 Alpha Branching of Actinium 227, by S. Peterson and A. Ghiorso, 3 p., September 1947. (ANL-JJK-14B-81). To be included in the NNES(MPTS).

By measurement of the rate of growth of alpha activity in an actinium sample purified from daughters, and alpha energy analysis of the same sample, Ac^{227} is found to decay 1.25 ± 0.02 per cent by emission of alpha particles of 4.95 ± 0.05 Mev.

*MDDC - 1744 The Radiocolloidal Properties of Some Fission Products, by J. Schubert, 1 p., January 12, 1948. (ANL-HDY-407).

For oral presentation at the American Chemical Society Symposium to be held in April 1948, and for publication in an abstract bulletin of the American Chemical Society.

The complete text of the report is reproduced herewith.

Under the proper conditions all of the radioelements found in fission will exhibit radiocolloidal behavior. Radiocolloidal behavior is exemplified by the following observations: (a) diminished diffusion velocity, (b) inability to penetrate membranes permeable to ordinary ions, (c) anomalous adsorption by ion exchangers, (d) coagulation by electrolytes, (e) precipitation upon high speed centrifugation, and (f) uneven darkening of a photographic plate.

The principal condition under which a radioelement present in solution will become a radiocolloid is through a reduction of the solubility to such a point that if the radioelement was present in macroscopic concentrations precipitation would result. The reduction in solubility can be effected either by adding a precipitating anion or cation, as the case may be, or, in the case of radioelements whose hydroxides are insoluble, by raising the pH to the macroscopic concentration value.

Experiments are described which show how pH or the composition of a solution results in inducing radiocolloidal behavior of fission products. A discussion is given of the criteria for detecting and studying radiocolloids from various types of experimental data. A consideration is given to the question as to whether radiocolloids are true colloids or the result of secondary effects.

Some applications and implications of radiocolloids to radiochemistry and biochemistry are presented.

*MDDC - 1745 Plutonium Project Record, Volume IX-B, Chapters 9 and 12, edited by N. Sugarman, Argonne National Laboratory, 80 p., n.d., decl. 2/17/48.

To be included in the NNES(MPTS).

This report is made up of a series of papers numbered MDDC - 1745-A through MDDC - 1745-G. These papers are individually abstracted below:

*MDDC - 1745-A The Separation of Long-Lived Fission Gases, by J. A. Ayres and I. B. Johns, 17 p., n.d., decl. 2/17/48.

Various methods of removing and recovering the radioactive fission product Xe isotopes from metallic U are described. A quantitative method involving solution in 92 per cent H_3PO_4 gives good recovery of both Xe and I activities. Disintegration of the metal upon formation of UH_3 releases only a small percentage of the Xe; somewhat more can be obtained by decomposing the hydride to metal and maintaining the latter at 400°C for some time or by the oxidation of UH_3 to UO_2. Suspension of the UH_3 in Hg releases only a few per cent of the Xe; but if the U metal amalgam, formed by the action of Hg on freshly decomposed hydride, is boiled, the Xe is rapidly liberated. Dissolution of the hydride in aqueous Ag salt solutions also liberates the radioactive Xe. Formation of UF_4 by the action of HF on UH_3 leads to the liberation of most of the radioxenon. A charcoal trap at -80°C will adsorb tracer quantities of Xe completely from a slow stream of He or a rapid stream of H_2. Heating the charcoal to 400°C and evacuating, leads to complete desorption of the Xe. The Xe is liberated completely on heating molten U metal to 1400°C or above.

*MDDC - 1745-B A Gas-Sweeping Apparatus for the Large Scale Collection of Fission Products on a Charged Wire, by S. Raynor, 17 p., n.d., decl. 2/17/48.

Many previous experiments have shown that gaseous members of fission chains formed in a solution can be swept out of the liquid into a stream of inert gas which is made to bubble through the solution. Further, the solid daughters of the radioactive gases so swept out are deposited on a highly negatively charged wire immersed in the stream of gas leaving the solution. This wire can then be used as a source of the radioactive daughters, by chemical separation of the desired element from the solution of or leachings from the wire.

The apparatus described in this paper was designed to carry out such a sweeping and collection of radioactive gases on a much larger scale than has hitherto been attempted. The apparatus consists of a chamber partly filled with an almost saturated solution of uranyl nitrate (UNH) in ordinary water, with means for bubbling an inert gas, such as N_2 through the solution. The chamber is exposed to the neutron flux in the thermal column of pile heavy water, and the fission gases swept out of the solution are collected on a charged wire. The wire can be easily removed from the apparatus for analysis.

*MDDC - 1745-C A Comparison of the Amounts of Fission Gases Swept from U and Pu Solutions, by R. M. Adams and H. Finston, 16 p., n.d., decl. 2/17/48.

Two experiments have been performed to compare the amounts of fission gases swept out of UNH solution with those amounts swept out of Pu solution under identical conditions. The charged wire technique was used. The essential data and results are tabulated. In general it was found that a considerably larger fraction of the activity was swept out of U solutions than out of Pu solutions.

*MDDC - 1745-D Interpretation of and Inferences from Results of Gas-Sweeping Experiments in U and Pu, by W. Rubinson, 7 p., n.d., decl. 2/17/48.

Examination of the data obtained in the experiments comparing the amount of fission gases swept from U and Pu solutions in the light of the phenomenon of the change in fission yield along a chain leads to a simple explanation of some of the anomalies. It is shown that although in most cases the fission yields in U and Pu differ by relatively small amounts, the total gas yield from U is in most cases more than twice as large as the total gas yield from Pu.

*MDDC - 1745-E New Barium and Cesium Isotopes: 12.0d Ba^{131} and 10.2d Cs^{131}, by S. Katcoff, 13 p., n.d., decl. 2/17/48. (See also Physical Review, Vol. 72, p. 1160-1164, December 15, 1947.)

A new Ba-Cs chain has been formed by the neutron activation of Ba. The chain has a tentative mass assignment of 131. The Ba^{131} isotope decays predominately by K-electron capture with a half-life of 12.d, emitting radiations of $\sim$0.26 Mev, 0.5 Mev, and 1.2 Mev (in low intensity). There are also present 31.5 Kev X-rays and 0.42 Mev and 0.24 Mev conversion electrons. The Cs^{131} decays exclusively by K-electron capture with a half-life of 10.2d emitting no γ radiations. The only radiations observed are the K X-radiations of Xe and some weaker radiations associated with the L X-radiation.

*MDDC - 1745-F Further Studies on the Radiations from Ba^{131} and Cs^{131}, by B. Finkle, 4 p., n.d., decl. 2/17/48. (See also Physical Review, Vol. 72, p. 1260-1261, December 15, 1947.)

The radiations of 12.d Ba^{131} and 10.2d Cs^{131} were examined for positrons, and none were found. Critical absorption measurements were made on the X-rays from Ba^{131} and they were found to be K α X-rays of Cs; likewise, the X-rays from Cs^{131} were found to be K α X-rays of Xe.

*MDDC - 1745-G A Long-Lived Barium Isotope, by S. Katcoff, 6 p., n.d., decl. 2/17/48. (See also Physical Review, Vol. 72 p. 1160-1164 December 15, 1947.)

A new Ba isotope has been formed by the neutron activation of Ba. This isotope has a tentative mass assignment of 133 and is the lower isomeric state of the 37.8h Ba^{133}. It decays by K-electron capture with a half-life of > 2y. The radiations observed are: 0.36 Mev γ-radiations, 0.34 Mev conversion electrons, and the K and L X-radiations of Cs.

*MDDC - 1746 **Van de Graaf Drawings: 2N 3835A, 2N 1485, 3A 5764A, 3A 5544, 2N 2594B, 2N 4344A, 2N 9254A, 2N 9534B, 3A 2745, 3A 8845, 3A 7045, by C. M. Turner, 12 p., 1946.**

Disposition as required for use in research, development, or manufacturing work. This also includes declassification of the Van de Graaf generator.

This document consists of twelve engineering drawings of a Van de Graaf generator designed at the Radiation Laboratory of the University of California, Berkeley.

Material lists are itemized and described. Titles are as follows: tank assembly, ion source assembly (includes new probe layout), generating volt-meter assembly, electron catcher - #2 assembly, gas compression plant flow diagram (schematic), accelerator tube assembly, corona tube assembly, textolite support tube assembly, low voltage end assembly, complete assembly, accelerator tube--complete.

MDDC - 1747 The Thermal Conductivity of Uranium Hexafluoride, by P. A. Agron and A. H. Taylor, 42 p., January 30, 1948.

For oral presentation at the April meeting of the American Chemical Society and for subsequent publication.

Measurements of the thermal conductivity of UF_6 (gas) have been made by the hot wire method and the value determined as $K=1.45\ (1+0.0048\ t^{o}c) \times 10^{-5}$ cgs. This value is in good agreement with that calculated by means of the Eucken equation, using the viscosity data and the heat capacity of the gas. Comparisons are also made with certain available experimental values. The average of all experimental and calculated values available is taken as the most probable value. Accordingly, the value of K, the thermal conductivity of UF_6 (g), becomes $K=1.46\ (1+0.0042\ t^{o}c) \times 10^{-5}$ cgs.

*MDDC - 1748 Correlation of Theories of Ion-Exchange Column Separations, by G. E. Boyd and L. A. Matheson, 2 p., n.d., decl. 2/26/48.

For oral presentation at the American Chemical Society Symposium to be held in April 1948.

The entire original abstract is reproduced here.

Although the mass transfer and plate theories of ion-exchange column performance have been formulated along radically different lines, each theory has been shown to give an equally good description of the behavior of deep bed. Evidently, therefore, a correlation of the parameters in the two theories should be possible. Further, an improved understanding of exchange column performance might be expected to result from such a comparison.

A consideration of the limiting expressions for the concentration of adsorbing solute in the effluent solutions (i.e., concentration history) from deep beds showed that a direct comparison of the theories could be achieved. One interesting correlation was that the "break-through" curves of the transfer theory could be computed by an integration of the plate theory formula for an "elution" curve.

In the case where the latter is given by the normal or Gaussian error curve, numerical values can be obtained easily. Another important result was the finding that the parameter y of the mass transfer theory was identical with p, the number of plates in the plate theory. Since the dimensionless quantity y is defined by:

$$y = (k\delta/f)\,(x/v) \qquad (1)$$

where k is the exchange rate constant, δ the equilibrium distribution coefficient, f the fractional bed void, x the bed depth, and v is the linear flow velocity; and, since the rate constant k may be given by the expression:

$$k = 3D^{l}/r_0\Delta r_0\delta \qquad (2)$$

where D^{l} is the ionic diffusion constant in the liquid phase, r_0 the radius of a spherical particle of exchanger and r_0 the film thickness, the following relation may be written for the number of theoretical plates, p:

$$p = (3D^{l}/r_0\Delta r_0)\,(x/v) \qquad (3)$$

Equation (3) may be employed to predict that the fractionating efficiency of an ion-exchange tower will increase with temperature, bed depth and with decreasing particle size, and will probably decrease slowly with the flow velocity. The results from an examination of the available experimental data in the light of equation (3) will be given.

•MDDC - 1749 **Equations of the Neher-Harper Circuit, by R. W. Cole, 13 p., October 3, 1946. (CP-3611).**

Disposition as required for use in research, development, or manufacturing work. This also includes the declassification of the Neher-Harper circuit.

An equation expressing the plate potential in a Neher-Harper circuit as a function of time is discussed in MDDC - 1750. MDDC - 1750 also contains data verifying the equation. A derivation of the equation is given in this report.

Differential equations are developed and solved expressing, as a function of time, after a Geiger count, the grid and plate voltages on the electron tube in a Neher-Harper circuit.

These equations show the criteria for circuit parameters giving satisfactory quenching action. Calculated and experimental data are compared and discussed.

•MDDC - 1750 **Experiments with the Neher-Harper Circuit, by R. W. Cole, 11 p., October 3, 1946. (CP-3609).**

Disposition as required for use in research, development, or manufacturing work. This also includes the declassification of the Neher-Harper circuit.

The action of a G-M counter involves the formation of a sheath of positive ions around the center wire and the subsequent removal of the ion sheath to the cathode. If the gas or gases in the counter are monatomic or diatomic, there are at least two processes which can liberate electrons from the cathode: (1) Photons produced in the avalanche near the center wire may reach the cathode and produce photo-electrons. (2) The positive ions when they are neutralized at the cathode may also liberate electrons. These electrons from the cathode when accelerated in the electric field may continue the discharge process. This report discusses how a Neher-Harper circuit prevents this discharge process from continuing indefinitely; and it offers an explanation of the pulses observed on the center wire and at the cathode with the aid of an oscilloscope. An equation expressing plate and grid potential on the electron tube in a Neher-Harper circuit as a function of time is discussed.

*MDDC - 1751 Observations on the Preparation of the Tribromide and Triiodide of Uranium, by E. D. Eastman, B. J. Fontana, and R. A. Webster, 9 p., n.d., decl. 2/18/48.

To be included in the NNES(MPTS).

Uranium tribromide has been prepared both by the reduction of the tetrabromide with hydrogen at 600-700°C, and by direct union of uranium and bromine at about 570°C. An attempt to prepare the triiodide of uranium by the latter method was unsuccessful.

*MDDC - 1752 The Direct Spectrochemical Analysis of Solutions Using Spark Excitation and the Porous Cup Electrode, by C. Feldman, 1 p., n.d., decl. 2/20/48.

For oral presentation before a meeting of the Optical Society to be held in March 1948.

The entire original abstract is presented here.

The Porous cup electrode consists of a $\frac{1}{4}$" by $1\frac{1}{2}$" cylindrical rod, with a 1/8" hole drilled along its axis from one end to within approximately 1.5 mm of the other end. It is used as the upper electrode, with the open end up. In operation, a long nosed pipette, containing 0.2 - 0.3 ml of the solution to be analyzed, is inserted into the cavity in the upper electrode until its tip touches bottom; the solution is then expelled as the pipette is withdrawn. The lower electrode is a solid 1/8" graphite rod. A synchronous spark from a 0.40 - 0.67 KVA source is applied for 5 - 15 seconds, using a 2 mm analytic gap. The heat thus produced helps the liquid to soak through the bottom of the porous cup, and reach the sparking surface. After a short (15 seconds) interval, the sparking is resumed and the exposure begun. The liquid feeds through of its own volition, constantly renewing the thin surface-film of liquid as it is dispersed by the spark. Spattering does not occur, as the spark never strikes the body of the liquid. Almost all of the spark's energy is dissipated in vaporizing and exciting the liquid film, so that the sample does not boil over. A sample of the size mentioned lasts as long as 240 seconds. Acid, neutral and slightly alkaline solutions have been used in strengths up to several per cent.

The following sensitivities (in ppm referred to the solution) have been obtained with 10% H_2SO_4 solutions, using only lines shorter than 4300 A: Al-2; B-10; Be-0.01; Ce-25; Co-2; Cr-3; Cu-1; Fe-3; K-300 Li-25; Mn-2; Na-250; Mg-0.01; Ni-10; Pd-3; Sn-100; Ti-5; Y-1; Zn-25; Zr-3. Quantitative analysis is performed by plotting log ($I_{element}/I_{int.\ std}$) against log $concn._{element}$. This gives a straight line with a slope lying between 1.0 and 1.3. The mean average deviation of duplicate results has been ± 5% or less.

*MDDC - 1753 The Chemistry of Americium Compounds, by S. Fried, 1 p., December 1947. (ANL-JJK-14B-91).

For oral presentation at the American Chemical Society Symposium to be held in April 1948, and for publication in an abstract bulletin of the American Chemical Society.

The entire original abstract is given here.

Americium dioxide has been prepared by ignition of the hydroxide in air at temperatures from 900 to 1400°C. Some variation in lattice constant was observed depending on the temperature of ignition.

Americium monoxide was prepared by action of hydrogen on AmO_2 at 800°C.

Americium trifluoride was prepared by action of an $HF-O_2$ mixture on AmO_2 at 600-750°C.

Americium trichloride was prepared by the action of CCl_4 on AmO_2 at 850°C.

Americium tribromide was prepared by action of $AlBr_3$ on AmO_2 at 500°C.

Americium triiodide was prepared by the action of AlI_3 on AmO_2 at 500°C.

All of these compounds are isomorphous with the corresponding compounds of plutonium and were identified by X-ray diffraction methods.

*MDDC - 1754 Nuclear Isomers Produced by Slow Neutron Capture, by M. Goldhaber and C. O. Muehlhause, 1 p., January 23, 1948. (ANL-HDY-411).

For oral presentation at the American Physical Society to be held in April 1948, and for publication in the Bulletin of the American Physical Society.

The entire original abstract is presented here.

A systematic investigation of nuclear isomers produced by slow neutron capture has been under way for some time. Some of the results are the following: By bombarding enriched stable isotopes of Cd the 48 minute isomeric transition in Cd is assigned to Cd^{111*}. The effective isotopic cross section for formation of this isomer, counting only internal conversion electrons, is found to be 0.2×10^{-24} cm^2 for activating Cd^{110}. The 17.5 second isomeric transition in Se is assigned to Se^{77*} by observing the (n,γ) reaction in enriched Se^{76}. Characteristic Kα radiation of Se accompanies the isomeric transition. Thus for both Cd and Se the metastable state is assigned to an odd mass nucleus in agreement with Mattauch's rule. In enriched In^{113} the 72 second In^{114} isomer is produced by thermal neutrons with a partial isotopic cross section of $(2 \pm 0.3) \times 10^{-24}$ cm^2, which is approximately 3% of the total capture cross section of In^{113}. The metastable state of Cs^{134} is assigned to the 3 hour period. Internal conversion electrons with a range in Al of 20 mg/cm^2, as well as characteristic Kα radiation of Cs are observed. The energy of transition is 160 kv. The effective cross section for production of this isomer, counting only internal conversion electrons, is approximately 3×10^{-24} cm^2. The internal conversion electrons from the 6.6 minute isomeric transition in Cb^{94} have been observed, as well as characteristic Kα radiation of Cb. From a study of the internal conversion electrons the energy of the transition is found to be about 50 kv. It leads to a long-lived ground state, the activity of which has so far not been detected ($T > 100$ years).

*MDDC - 1755 Preparation and Properties of the Uranium Halides, by N. W. Gregory, 77 p., n.d., decl. 2/18/48. (BC-6).

To be included in the NNES(MPTS).

The most extensive studies of the uranium halides have been confined principally to the tetrachloride and the hexafluoride. Considerable additional information has been obtained regarding the bromides, iodides, oxyhalides, and the mixed halides. This paper contains a summary of the information acquired regarding the methods of preparation and the physical and chemical properties of these compounds. Nearly all of the mixed halides, which involve chlorine, bromine, and iodine, in the trivalent and tetravalent states of uranium, have been prepared. Many had not been prepared prior to the work discussed herein and the nomenclature applied to these compounds is based on that commonly accepted for similar compounds of other elements. Information given in this work pertains only to experimental results from the Radiation Laboratory, University of California, although reference is made to results reported by other investigators. Work which has been concerned with the uranium chlorides, with the exception of UCl_3, will be discussed in another paper. Very little has been done here with regard to the uranium fluorides.

*MDDC - 1756 Neutron Scattering Resonances in Elements from Calcium to Bromine, by S. P. Harris and A. S. Langsdorf, Jr., 1 p., January 14, 1948. (ANL-HDY-402).

For oral presentation before a meeting of the American Physical Society to be held in Washington, D. C., April 20 - May 1, 1948, and for publication in the Bulletin of the American Physical Society.

The entire original abstract is reproduced here.

Since the discovery of the predominantly scattering character of the resonance in Mn for 300 ev neutrons, a search for similar resonances has been made using an annular BF_3 proportional counter as described in a published report on the scattering character of the 115 ev Co resonance. Similar resonance scattering have been observed in Cu and Ga, and indications are found of such resonances in V and As. The latter two are more difficult to measure because the presumed resonances are above 1000 ev where the sensitivity of detection becomes low. Resonance scattering in the measurable energy band (below 10,000 ev) in Ti, Cr, Fe, and Ni are not observed. In this energy region the available evidence indicates that in this region of atomic weights there is a systematic pattern such that odd Z elements have scattering resonances while even ones do not. This evidence correlates with a not unexpectable difference between level widths and spacings in odd Z-odd N compound nuclei and all others. (However, the even Z-odd N isotopes have too low abundance to determine their resonance properties without use of separated isotopes.)

By the time of the meeting confirmatory evidence is expected upon the above elements which are still doubtful and in addition, upon Ca, Zn, Ge, Se, and Br. To the extent possible, tests for resonance

(Cont'd on next page)

*MDDC - 1756 Neutron Scattering Resonances in Elements from Calcium to Bromine, by S. P. Harris and A. S. Langsdorf, Jr., 1 p. January 14, 1948. (ANL-HDY-402) (Cont'd from page 186)

scattering in a representative sample of lighter and heavier nuclei will also be reported on, including a few even and odd elements among those listed below in three regions of the periodic chart, (Na, Mg, Al, Si, P, S, Cl, K), (Cb, Mo, Ag, Cd, In, Sn, Sb, Te, I, Ba, La, Ce), and (Ta, W, Au, Hg, Tl, Pb, and Bi).

*MDDC - 1757 Ionic Species of Plutonium Present in Aqueous Solutions of Different Acids, by J. C. Hindman, 1 p., December 1947. (ANL-JJK-14B-96).

For oral presentation at the American Chemical Society Symposium to be held in April 1948, and for publication in an abstract bulletin of the American Chemical Society.

The entire original abstract is reproduced here.

Measurements on the Pu(III) - Pu(IV) oxidation potential in mixed HCl - NaCl solution have established the acid independence of the couple at hydrogen ion concentration from 0.3 molar to 1.0 molar and, from this result the conclusion drawn that the plutonium (IV) ion in solution above 0.3 M acid in the absence of complex forming anions is largely the hydrated Pu^{+4} ion.

The potentials of the Pu(III) - Pu(VI) and Pu(IV) - Pu(VI) couples are strongly hydrogen ion dependent. From the data available both couples appear to vary with the fourth power function of the hydrogen ion concentration.

Spectrophotometric observations have been correlated with the potential measurements. On the basis of these correlations and other evidence it has been concluded that the ions present in one molar perchloric acid solutions are Pu^{+3} (hydrated), Pu^{+4} (hydrated) and PuO_2^{+2} (hydrated). The relative complex forming tendencies of various anions are discussed.

MDDC 1758 Hemin Synthesis with Glycine Containing C^{14} in Its Alpha-Carbon Atom, by K. I. Altman, et al., 7 p., February 1948. (II-188-7587).

For publication in Federation Proceedings.

It has been shown by Shemin and Rittenberg that the nitrogen component of glycine is incorporated in the hemin of hemoglobin. This left unanswered the question whether the carbon skeleton of glycine would also function as a specific precursor of the pyrrol in hemin. In order to investigate the latter po nt, $C^{14}H_2NH_2COOH$, prepared by R. Ostwald (Radiation Laboratory, University of California), was fed to normal rats and to rats which had been rendered anemic by previous phenylhydrazine feeding. These animals were rapidly forming new erythrocytes as indicated by a high reticulocyte count. The radioactive glycine was administered by stomach tube in a single dose of approximately 1μc/100 gm body weight. At varying intervals animals were bled as completely as possible from the carotid artery. Hemin was prepared following M. Nencki and J. Jaleski, globin according to M. L. Anson and A. E. Mirsky, and hemoglobin by crystallization after hemolysis. C^{14} was determined according to a method developed by W. F. Bale and R. E. Masters. It was found that C^{14} was incorporated in hemin and globin as early as 24 hours after feeding in the normal and anemic groups. The C^{14} activity of hemin was greater in the phenylhydrazine-treated animals as compared with the normal ones. The concentration of C^{14} per gram hemin was about 7-9 times that found per gram globin. From this evidence it is concluded that the alpha-carbon of glycine is a direct precursor of a portion of the hemin molecule.

MDDC - 1759 Neutron Deficient Isotopes of Tellurium and Antimony, by M. Lindner and I. Perlman, 4 p., n.d., decl. 2/24/48. (UCRL-39).

For publication as a Letter to the Editor of the Physical Review.

Several new neutron-deficient isotopes of tellurium and antimony have been found. These include a 6.0 day electron-capture tellurium, assigned to Te^{118}, a 4.5-day electron-capture assigned to Te^{119} and a 2.5-hour activity not further identified. A 6.0-day antimony K-capture isotope, not to be confused with the tellurium activity of similar half-life, and consisting principally of X-rays and hard γ-rays has been found but has not as yet been identified.

*MDDC - 1760 The Oxidation States of Neptunium in Aqueous Solution, by L. B. Magnusson, J. C. Hindman, and T. J. LaChapelle, 1 p., January 1948. (ANL-JJK-14B-111).

For oral presentation at the American Chemical Society Symposium to be held in April 1948, and for publication in an abstract bulletin of the American Chemical Society

See also MDDC-1266.

This article is an abstract and is presented here in its entirety.

Isolation of a milligram of the long-lived isotope $_{93}Np^{237}$, formed by nuclear transmutation, permitted positive identification of the oxidation states of neptunium stable in 1 molar solutions of HCl, $HClO_4$, HNO_3 and H_2SO_4. The highest state obtainable w th strong oxidizing agents was Np(VI) as established by precipitation of the salt, sodium neptunyl acetate, $NaNpO_2(OOCCH_3)_3$. Each oxidation state has a markedly different and characteristic absorption spectrum. Spectrophotometric titrations of various acidic solutions of neptunium with oxidizing and reducing agents revealed the stable existence of the +4, +5, and +6 states. The +3 state was produced by electrolytic reduction of the +4 state in 1 molar HCl under a nitrogen atmosphere. The absorption spectrum for each state was surveyed over the range 350 - 1000 millimicrons with a quartz prism spectrophotometer. Formal oxidation potentials for the neptunium couples in 1.0 M HCl were measured at 25°C. The values are Np(III)→Np(IV) (-0.14), Np(IV) → Np(V) (-0.74), Np(V)→Np(VI) (-1.14) in volts vs the standard hydrogen electrode, with junction potentials neglected. Np(V) is quite stable in solution contrasting sharply with the much less stable +5 states of uranium and plutonium.

MDDC - 1761 Ultramicrochemical Investigation of the Solubilities of Some Plutonium Compounds, by D. F. Mastick and A. C. Wahl, 7 p., February 22, 1944. (LADC-182).

Disposition as required for use in research, development, or manufacturing work.

The solubilities of the iodate and peroxide of the +4 state, and the fluorides and oxalates of the + 4 and +3 states have been investigated. A discussion of the preparation of the lower state of plutonium (purple aqueous solution)is given. Solubility tables are given for the following: $Pu(IO_3)_4$, plutonium oxalate, plutonium peroxide, and plutonium fluoride.

*MDDC - 1762 Equilibrium and Rate Measurements on the Exchange Adsorption of Several of the Trivalent Rare Earths, by L. S. Myers, Jr. and G. E. Boyd, 1 p., n.d., decl. 2/26/48.

For oral presentation at the American Chemical Society Symposium to be held in April 1948.

This article is an abstract and is presented here in its entirety.

In a recently published research release the complete separation of milligram quantities of all fourteen of the rare earths by means of ion-exchange column techniques was reported. Concurrent with this study, determinations were made of the equilibrium exchange of the trivalent cations of lanthanum, cerium and yttrium from dilute acid solutions with a commerically available phenolform-aldehyde type exchanger. Distinct, although small, differences in the degree of exchange were found, the sequence of adsorbability being: La(III)>Ce(III)>Y(III), in agreement with prediction. Linear isotherms were found through the employment of radio-isotopic tracer techniques, to hold from a minimal rare earth concentrations of 10^{-10} up to approximately 10^{-6} M.

Measurements also of the rate of exchange of La(III), Ce(III) and Y(III) cations from acid, salt and citrate buffer solutions were made using a "shallow-bed" or single stage technique. With particle diameters greater than 0.02 cm diffusion in and through the body of the exchanger was found rate determining. Further, the adsorption velocity was observed to be very much slower for highly charged rare earth ions than was found earlier with the alkali metal cations.

As a consequence of these equilibrium and rate studies it is believed that a further insight into the mechanisms operating in the ion-exchange column separations of the rare earths has been gained.

MDDC - 1763 The Cultivation of the Hematopoietic Tissues by Tissue Culture Methods, by P. E. Rekers, 49 p., January 1948. (M-2013).

To be presented at seminars of the Medical School of the University of Rochester, and for publication in the American Journal of Roentgenology.

Cultivation of normal adult bone marrow from dog and rabbit resulted in an immediate and abundant migration or proliferation of cells from the explant. For the most part these cells were of the myeloid series and in the latter stages of maturation. This migration persisted up to about 4 days after explantation when fibroblast growth began and overran the culture within 10 to 14 days.

The cultivation of bone marrow by roller tube and flask techniques shows no significant differences in the rate, the magnitude, or duration of growth. Slide cultures invariably showed less evidence of growth but were more suitable for detailed cytological examination.

A study of standard media such as chicken plasma, heterologous adult and/or embryonic sera, embryonic jucies and salt solutions indicates that long term cultivation of hematopoietic tissues can not be sustained by the media and proportions so tested.

The absence or variations in concentration of dextrose has no appreciable inhibiting or stimulating effect on marrow cells.

High concentrations of O_2 and high concentrations of CO_2 initially promote growth, but the end result is about the same.

The freezing of media does not appear to effect the growth of cells in tissue culture.

Bone marrow, explanted from animals whose marrow had been stimulated by acute bleeding or subcutaneous injection of turpentine, shows marked increase in cellularity.

The cultivation of marrow from radiated animals indicates that the production of marrow parenchymatous elements decreases with time after radiation up to and including the 21st day of radiation. Beginning with the 28th day after radiation, a production of parenchymatous cells is again noted.

Cultivation of the spleen results in an initial outpouring of round cells, probably lymphocytes. As these cells disintegrate, small granular cells with processes are seen. In all probability these latter cells are early fibroblasts.

The cultivation of embryonic spleen and bone marrow did not differ conspicuously from the cultivation of adult spleen and bone marrow.

A bibliography of 46 references is included.

MDDC - 1764 Homotransplantation of the Mammalian Adult Kidney, by P. E. Rekers, 12 p., December 18, 1946.

For publication in Archives of Surgery.

During the course of study of the toxicity of uranium and its compounds it was found that the incidence and degree of renal damage encountered in industrial and laboratory personnel was a great deal less than expected and accordingly less attention need be directed to therapeutic measures. However because of anticipated renal damage techniques were developed for transplantation of a normal kidney.

A technique is described for the homotransplantation of a kidney in the dog.

The transplantation of a kidney to the neck region employing the cannula technique for blood vessel anastomosis was found to be more desirable.

Renal function of the homotransplanted kidney lasted from 1-5 days.

Drawings showing techniques are included.

MDDC - 1765 Comparison of Methods of Obtaining Surface Area of Crystalline Solids from Vapor Adsorption Isotherms, by S. Ross, 24 p., January 27, 1948. (CNL-13).

For oral presentation at the American Chemical Society Symposium to be held in April 1948, and for publication in an abstract bulletin of the American Chemical Society.

The abstract of this documnet has previously been issued as MDDC-1711 and listed in this journal.

MDDC - 1766 Operation and Service Notes on a Batteryless Type-A Counting System Using Parallel Plate or Concentric Cylinder Chambers, Mark 6 Model 30 and Mark 10 Model 32, by J. A. Schoke, 8 p., May 24, 1945. (MUC-WPJ-131).

Disposition as required for use in research, development, or manufacturing work.

The purpose of the report is to furnish information which will aid in the operation and servicing of the "A" counting system. The following points are included:

The circuit will operate correctly in the middle of the gain plateau with variations of line voltage from 105 to 130 volts. A caution in turning on the scaler to prevent a breakdown in the filter condenser is mentioned. Optimum voltage for the system is set at 1250 volts. Counting rates should not exceed 50,000 c.p.m. Plateau lengths of seven points or more on the attenuator show correct operation. A method for unblocking the "trigger" is indicated. A sweep frequency of 60 c.p.s. is most desirable, because then any voltage supply or line pickup is very noticeable in the scope picture.

The requirements of the pre-amplifier necessitates the classifying of 6AK5 tubes into groups according to the stage in which they are employed. The voltages given on the circuit diagram are the average values found from a number of circuits and they may vary slightly for any particular circuit. The 6AC7 is operated with its plate depressed so that it is operating in the region where its plate resistance is a function of the plate voltage. The frequency response of the system is determined by using an enclosed circuit diagram. Amplifier noises, amplifier gain, resistor board and standard chamber are discussed.

A scaler trigging sensitivity vs. frequency chart and a circuit diagram are attached.

MDDC - 1767 The System Uranyl Sulfate - Water, I. Temperature - Concentration Relationships below 300°C, by C. H. Secoy, 9 p., January 28, 1948. (CNL-18).

For oral presentation at the April meeting of the American Chemical Society and also for publication in a journal of the American Chemical Society.

The temperature-concentration diagram for the system uranyl sulfate-water is presented and the results discussed. The stable hydrates are the trihydrate and monohydrate. A dihydrate, metastable with respect to the trihydrate, was formed under certain conditions. The ice-trihydrate eutectic was found at -38.5° C and at a composition of 3.82 molal. The solubility of the trihydrate increases with temperature to the transition to the mononydrate at 181°C and a concentration of 8.66 molal. The monohydrate shows retrograde solubility.

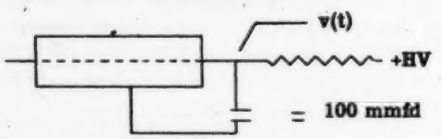
Activity coefficients for uranyl sulfate, calculated from the freezing point data without benefit of heat capacities, agree well with those of other bivalent metal sulfates at concentrations below one molal but rise more rapidly than those for the other sulfates above this concentration.

Investigation at higher temperatures with a one molal solution shows that at about 325°C a second liquid phase appears. The aqueous phase undergoes critical transformation at or very near the critical temperature of pure water, indicating tht the solubility of salt in water has reached a very low value at or below the critical temperature of water.

*MDDC - 1768 Equations for the Pulse from a G-M Counter, by R. W. Cole, 4 p., September 26, 1946. (CP-3610).

Disposition as required for use in research, development, or manufacturing work.

This report discusses equations expressing the potential of the center-wire as a function of the time when the counter is operated in the following circuit:



An argument is presented by which Ramsey's equation for a Geiger pulse may be generalized. The generalized equation thus obtained has not been verified experimentally.

*MDDC - 1769 Plutonium Project Record, Volume IX-B, Papers from Chapter 6, Introduction to Fission edited by N. Sugarman, Argonne National Laboratory, 67 p., n.d., decl. 2/16/48.

To be included in the NNES(MPTS).

This report consists of a series of papers, numbered MDDC-1769-A through MDDC-1769-J. These papers are individually abstracted below:

*MDDC - 1769 - A A Comparison of Individual Fission Activities with the Gross Activity (Summation Study), II, by W. Rubinson, et al,, 21 p., n.d., decl. 2/16/48.

The gross and sum decays, β and γ, of the long-lived fission products were followed for some 600 days, beginning 118 days after end of bombardment. The excellent agreement between the sum and gross β's gives fair assurance that no significant long-lived β-emitting fission product remains undiscovered. A discrepancy of 3-9 per cent between the sum and gross γ does not permit us to say with as much assurance that no significant γ emitter remains undiscovered, but we feel the discrepancy is due to experimental error. As by-products of the summation study, two γ's associated with the 17m Pr daughter of 275d Ce were found and verified the existence of a long-lived rare-earth isotope of half-life 4y. Curves are given for the percentage contributions of the different β and γ activities to the total β and γ as a function of time. A comparison of these percentages with those calculated from fission yields and half-lives shows reasonable agreement.

***MDDC - 1769 - B** Calculation of γ Wattage Escaping from the Slug in the Calorimetric Experiments, by K. Way, 2 p., n.d., decl. 2/16/48.

The calculated percentage of γ watts escaping from the calorimeter in the experiments described by Day and Cannon is probably too low by a factor of 4. The percentage of total wattage escaping is 21.3 per cent as compared to the reported value of 6.4 per cent. The corrected values seem to give better agreement with other results. The error in the original calculation arises from the value taken for the absorption coefficient of air.

***MDDC - 1769 - C** Ranges of Fission Recoil Fragments of Known Mass Numbers, I, by M. S. Freedman, R. P. Metcalf, and N. Sugarman, 6 p., n.d., decl. 2/16/48.

The ranges in air of certain fission fragments were measured after they had traversed 1.4 mg/cm^2 of Al. The experiments were done in a small chamber in which the air pressure could be varied. The recoils from a U foil were collected on a cellophane disc which was then radiochemically analyzed for Ba and Sr. The activities isolated under the conditions of the experiment were mostly 86m Ba^{139} and 9.7h Sr^{91}. The Ba and Sr activities were observed to decrease rather uniformly with increasing air pressure, and they reached zero at 1.0 cm of air (S. T. P.) and 1.52 cm of air (S. T. P.), respectively. This corresponds to ranges of 1.94 cm air and 2.45 cm air (S. T. P.) for Ba^{139} and Sr^{91}.

*MDDC - 1769 - D Ranges of Fission Recoil Fragments of Known Mass Numbers, II, by B. Finkle, E. Hoagland, S. Katcoff, and N. Sugarman, 11 p., n.d., decl. 2/16/48.

Experiments similar to those described in MDDC-1769-C have been performed, but several improvements and additions have been introduced. Instead of a thick Al absorber (1.4 mg/cm^2) to prevent the diffusion of stopped recoil fragments to the cellophane collecting disc, a very thin zapon film (0.01 mg/cm^2) was used. The experiments were performed with both an enriched U foil and a Pu foil. Absorption curves in air of the fission recoils approximate those which would be obtained for particles under the same geometrical conditions. The ranges observed for the recoil fragments from U are 1.75 cm in air (S. T. P.) for Ba^{139} and 2.45 for Sr^{91}. From Pu the ranges are 1.85 cm for Ba^{139} and Ba^{140}, and 2.55 cm for Sr^{91}.

*MDDC - 1769 - E Ranges of Fission Recoil Fragments of Known Mass Numbers, III, by B. Finkle, E. Hoagland, S. Katcoff, and N. Sugarman, 12 p., n.d., dec. 2/16/48.

Ranges have been determined for some fission recoil fragments of U of known mass numbers using the technique of Segre and Wiegand. The fission recoils are stopped in thin Al absorbers, each of which is analyzed for a given set of fission activities. The curves of activity vs mg Al absorber are represented by straight lines over most of the range.

A set of range values in Al, (obtained by an extrapolation to zero activity of the straight line portion of the range curve), and their corresponding mass numbers are given in a table.

***MDDC - 1769 - F** Triple Fission, I, Sulfur, by R. P. Metcalf, 3 p., n.d., decl. 2/16/48.

A search was made for radioactive sulfur as a possible product of triple fission. An upper limit of 1.8×10^{-4} per cent was set for the fission yield of the 87d isotope.

The source of active material was a nitric acid solution of a slug which had been irradiated in the Clinton pile for 9 days. The analysis was completed fifty days after the end of the irradiation. Details of the analytical procedure are given.

***MDDC - 1769 - G** Triple Fission, II. Chlorine, by J. A. Seiler, 3 p., n.d., decl. 2/16/48.

A search was made for Cl as a possible triple fission product in a solution of an active slug. Upper limits of 6×10^{-5} to 0.17 per cent were set for the fission yields of isotopes ranging in half-life from 1 day to 10^3 years.

*MDDC - 1769 - H Triple Fission, III. Calcium, by E. P. Steinberg, 3 p., n.d., decl. 2/16/48.

A search was made for radioactive Ca as a possible product of triple fission. An upper limit of $\sim 10^{-4}$ per cent was set for the fission yield of isotopes ranging in half-life from 2 to 180 days and 2.1×10^{-3} per cent for the 8.5d isotope.

Details of the analytical procedure are given.

*MDDC - 1769 - I Triple Fission, IV. Scandium, by L. Winsberg, 3 p., n.d., decl. 2/16/48.

As part of the program of investigation for possible triple fission, a search was made for Sc isotopes in 1.0 ml of an active UNH solution. An upper limit of $\sim 10^{-4}$ per cent was set for the fission yield of isotopes ranging in half-life from 2.5 days to 1 year.

Details of the analytical procedure are given.

***MDDC - 1769 - J** **Triple Fission, V. Iron, by R. P. Metcalf, 3 p., n.d., decl. 2/16/48.**

A search was made for radioactive iron as a possible product of triple fission. An upper limit for the fission yield of 47d Fe of 4×10^{-5} per cent was set.

The source of active material was a nitric acid solution of a slug which had been irradiated in the Clinton pile for 9 days. The analysis was completed 16 days after the end of irradiation. Details of the analytical procedure are given.

***MDDC - 1770** **The Isolation of Protactinium from Uranium Ore Residues and Some Observations on Its Chemical Behavior, by R. C. Thompson, 1 p., January 1948. (ANL-JJK-14B-104).**

For oral presentation at the American Chemical Society Symposium to be held in April 1948, and for publication in an abstract bulletin of the American Chemical Society.

The complete text is given below.

Studies on the chemistry of protactinium were carried on in three broad catagories: (1) tracer scale studies of coprecipitation, adsorption and solvent extraction, (2) development and application of procedures for the extraction of milligram amounts of protactinium from natural sources and (3) some milligram scale adsorption, solvent extraction and solubility studies.

Coprecipitation studies point to the likelihood that absorption phenomena are chiefly involved. Protactinium is adsorbed from acid solution, probably in colloidal form, on Amberlite IR-1, a cation exchange resin. Amberlite IR-4, an anion exchange resin has been successfully employed to adsorb protactinium from hydrofluoric acid solution, probably as the PaF_7^- ion. Protactinium nitrates and chlorides can be extracted from aqueous solutions into suitable organic solvents.

Using adsorption and solvent extraction methods for final purification, and coprecipitation with manganese dioxide for concentration, twenty milligrams of pure protactinium were isolated from uranium ore residues. Preliminary solubility studies of protactinium oxide in hydrochloric, nitric, sulfuric and perchloric acid suggest strongly that such solubility as is observed must be attributed to the formation of complex ions.

*MDDC - 1771 Problems Encountered in the Design of a Radioisotope Building, by P. C. Tompkins, 1 p., n.d., decl. 3/1/48.

For oral presentation at the American Chemical Society Symposium to be held in April 1948, and for publication in an abstract bulletin of the American Chemical Society.

The complete text is given below.

The design of a building devoted to the processing of radioisotopes is presented. Techniques are to be based on the development of unit processes at all levels of activity except those that can be handled adequately by "aseptic" analytical techniques.

The most specialized section contains cells (cubicles) with 3 foot concrete walls. The shielding design is based on 50 curies of 2 Mev γ whereas the contamination problem is based on 1 curie/ml and 1000 curie total activity of all radiation types. Facilities for implementing the operational methods are built in wherever possible. Other facilities designed for dealing with 1 curie of 2 Mev γ for storage and decontamination of equipment are described. The general ventilation pattern and the waste disposal system are also shown.

The general layout of the building, the relations between areas, and the operational regulations that are necessary to make the building function efficiently and safely are discussed.

*MDDC - 1772 The Isolation and Properties of Curium, by L. B. Werner and I. Perlman, 1 p., December 1947. (ANL-JJK-14B-83).

For oral presentation at the American Chemical Society Symposium to be held in April 1948, and for publication in an abstract bulletin of the American Chemical Society.

The complete text is given here.

Curium in the form of the isotope Cm^{242} has been isolated in relatively pure form. Microgram quantities were made by transmutation of Am^{241} in a high flux of neutrons. The emission spectrum and the absorption spectrum in solution have been measured and certain other chemical properties which can only be determined at macro concentrations have also been measured. The absorption spectrum when compared to other heavy elements is analogous to that of gadolinium in the rare earth series. This finding along with the apparent predominance of the trivalent state for curium gives added evidence for placing curium as the seventh element of a heavy element transition series.

*MDDC - 1773 Thermochemical Measurements on the Transuranium Elements, by E. F. Westrum, Jr., 1 p., January 1948. (ANL-JJK- 14B-105).

For oral presentation at the American Chemical Society Symposium to be held in April 1948, and for publication in an abstract bulletin of the American Chemical Society.

The complete content is given below.

The heats of reaction of plutonium metal, trichloride, tribromide, and oxychloride with aqueous hydrochloric acid and the heat of precipitation of the trifluoride have been accurately measured using ten to a hundred milligram samples in a small vacuum-walled calorimeter. The dependence of the heat of solution of the trichloride on the concentration of hydrochloric acid has also been determined over a considerable range. From these data the heats of formation of the compounds and the aqueous plutonium (III) ion have been calculated and correlated with other measurements on uranium and the transuranium elements.

The calibration and performance of a microcalorimeter designed to permit the precise determination of heats of solution and reaction of quantities of about one milligram of the rarer transuranium elements and their compounds is deseribed. This has been used in determining the heat of formation of neptunium trichloride and is being used for americium. A slight modification of the instrument (substitution of a silver adsorber for the reaction vessel) made possible the calorimeter measurement of the rate of energy production by alpha-disintegration of curium (242) and the estimation of the half-life period in good agreement with that obtained by radiophysical methods.

*MDDC - 1774 Plutonium Project Record, Volume IX-B, Radiochemistry and the Fission Products Papers from Chapter 7, Data on the Fission Products edited by N. Sugarman, Argonne National Laboratory, 149 p., n.d., decl. 1/19/48.

To be included in the NNES(MPTS).

This report is made up of a series of papers numbered MDDC - 1774-A through MDDC - 1774-AA. These papers are individually abstracted below:

*MDDC - 1774-A Absence of Long-Lived As in Fission, II, by G. R. Leader, 3 p., n.d., decl. 1/19/48.

No long-lived As activity with a half-life of 50-400d was found to be formed in fission with a yield greater than 5×10^{-6} per cent.

If any long-lived As activity is formed, it must have a very long half-life and/or very soft radiations.

For the known 16d As^{74} and the 90d $As^{72, 73}$ isotopes, which must be formed directly in fission because their potential Ge parent isotopes are stable, the 10^{-6} per cent fission yield is an upper limit since the chemical identification of the activity as As was not absolutely rigorous.

*MDDC - 1774-B Chemical Isolation of the 56s Br and the 23s I Delayed Neutron Activities, by J. S. Levinger, et al., 8 p., n.d., decl. 1/19/48. (See also MDDC - 34)

The existence of delayed neutron activities with half-lives of 57s and 23s has been demonstrated by Snell, Nedzel, and Ibser. Members of the Chicago Cyclotron Section later found that the half-lives of the shorter activities were 4.5s, 1.8s, and ~0.4s. The half-lives 0.4s, 1.8s, 4.5s, 23s, and 57s account fairly well for the total decay curve from 0.4s on. The presence of discrete decay periods is good evidence for the Bohr-Wheeler theory that delayed neutrons originate in the fission products and are emitted when the β-decay of a fragment leaves the nucleus in a state of excitation higher than the binding energy of a neutron in that nucleus. The neutron is then immediately emitted, and the rate of decay of the neutron-emitting activity is that of the preceding β-activity.

*MDDC - 1774-C The Characteristics of 57d Y^{91}, compiled by R. R. Edwards, 4 p., n.d., decl. 1/19/48.

Project work has demonstrated for 57d Y a mass number of 91, a maximum β energy of 1.6 Mev and a fission yield in U of 5.9 per cent.

*MDDC - 1774-D The Characteristics of 53d Sr^{89}, compiled by R. R. Edwards and A. F. Voigt, 5 p., n.d., decl. 1/19/48.

Project studies of Strontium^{89} have indicated a half-life of 53d, a maximum β^- energy of 1.5 Mev and a fission yield in U of 4.6 per cent.

*MDDC - 1774-E The Identification of Sr^{90} and Y^{90} in U Fission, by R. W. Nottorf, 7 p., n.d., decl. 1/19/48.

The discovery of a long-lived Strontium activity and its shorter-lived Ytterium daughter is reported. The Y isotope was identified with the known ~ 60h Y^{90}, and its half-life was shown accurately to be .65h. Decay measurements of Sr^{90} over 30 months have indicated a period of 23 $\pm$3y.

*MDDC - 1774-F Further Studies on Sr^{90} and Y^{90}, by L. E. Glendenin and C. D. Coryell, 5 p., n.d., decl. 1/19/48.

The presence of the Strontium^{90}-Ytterium^{90} chain in Uranium fission, as reported by Nottorf (See MDDC - 1774-E), was confirmed in experiments with samples of fission Sr several months old. In the earliest experiments, Sr samples which had decayed for up to 7 months yielded appreciable quantities of ~ 60h Y in chemical separations.

Absorption curves of the Sr^{90} and Y^{90} radiations in Al have indicated maximum β^-energies of 0.6 Mev for the former and 2.2 Mev for the latter. The half-life of Sr^{90} has been estimated from fission yield considerations to be 24-30y. The best value is taken as 25y.

*MDDC - 1774-G Discovery and Characterization of the 10h Y Fission Product, by N. E. Ballou, 6 p., n.d., decl. 1/19/48.

Yttrium was isolated from neutron-irradiated UNH, and its decay curve was observed. In addition to the known periods of about 4h and 57d, a new period of about 11h was found. At a later date, Hahn and Strassmann published evidence for the existence of the isotope as a daughter of a 7m Sr. A more detailed study of the energies of the radiations is presented.

An Y period of 10h has been found in the fission products which has a maximum β energy of 3.1 Mev and a γ energy of 0.7 Mev.

*MDDC - 1774-H Half-Life and Radiations of 5.9h 43^{99}, by L. E. Glendenin, 6 p., n.d., decl. 1/18/48.

The 5.9h isotope of element 43 was discovered by Seaborg and Segre, who isolated the activity from neutron- and deuteron-irradiated Mo samples and showed that it was the daughter of 67h Mo^{99}. These workers also reported that this activity decays by isomeric transition with the emission of γ rays, conversion electrons, and X-rays, to an undetected long-lived ground state, and gave its half-life as 6.6 ± 0.4h.

In the report, the isolation of this isotope of element 43 both from the fission products of U and pile-irradiated Mo is described. A half-life of 5.9 ± 0.2h is obtained. The radiations consist of soft conversion electrons (range of $\sim 20 mg/cm^2$ of Al corresponding to ~ 0.12 Mev) and γ radiation.

*MDDC - 1774-I Discovery of the 10^6y $43^{(99)}$ Isotope, I, by D.C. Lincoln and W.H. Sullivan, 7 p., n.d., decl. 1/19/48.

A long-lived activity was found to follow the chemistry of element 43. It was concluded that the isotope responsible was $43^{(99)}$, as based on theoretical considerations from the Bohr-Wheeler calculations. From the assumed fission yield, the half-life was estimated as $\sim 10^6$y.

The separation of element 43 from most of the fission products was initiated by a perchloric acid distillation of the residual solution left after removal of uranyl peroxide from a solution of bombarded uranium metal.

*MDDC - 1774-J The Characteristics of 7.6d Ag^{111}, compiled by J.H. Goldstein, 5 p., n.d., decl. 1/19/48.

The 7.6d Ag^{111} is found in fission as the daughter of the 26m Pd. Two β components have been observed, with energies of 1.0 Mev and ~ 0.2 Mev. A γ ray in low intensity also may be present, conversion of which probably accounts for the weaker β component.

The U^{235} fission yield of the 7.6d Ag is 0.018 per cent.

*MDDC - 1774-K Characteristics of the 54m I, compiled by J. H. Goldstein, 1 p., n.d., decl. 1/19/48.

The 54m Iodine occurs in fission as the daughter of the 43m Tellurium. The energy of the β radiation is not known. A γ component of $>$ 1 Mev has been observed. The mass of the 54m I is not certain, but is estimated as 134. A yield of $\sim$ 5.7 per cent in U fission has been determined.

*MDDC - 1774-L The Characteristics of the 5.3d Xe^{133}, I, by N. Elliott, 5 p., n.d., decl. 1/19/48.

The half-life of $Xenon^{133}$ was found to be 5.3d; its radiation characteristics consist of β radiations of 0.34 Mev not previously observed, and X-rays of about 40 Kev arising from the interval conversion of an 83 Kev γ ray.

*MDDC - 1774-M Mass Assignment of 33y Cs, by A. Turkevich, E. P. Steinberg, B. Finkle, and N. Sugarman, 3 p., n.d., decl. 1/19/48.

The bombardment of Xenon with neutrons produced an active Cesium deposit whose absorption characteristics are identical with those of the 33y Cs separated from irradiated U. The mass number of the 33y Cs is shown to be 137. The cross section of Xe for the formation of Xe^{137} by thermal neutron bombardment is ~0.014 barn.

*MDDC - 1774-N Search for Cs^{135} from Xe^{135}, by D. W. Engelkemeir, 1 p., n.d., decl. 1/19/48.

The entire document is reproduced here.

An attempt was made to find the active Cs^{135} daughter of the 9.2h Xe^{135} since it was shown that the 33y Cs found in fission was not a member of the 135 chain.

Approximately 30 mc of 9.2h Xe^{135} was pumped into a glass bulb and allowed to decay for several days. The gas and bulb walls were washed with cold 6N HNO_3, then the gas was pumped out, and a second washing made with hot 6N HNO_3 plus Cs carrier. Cesium analyses were carried out on 40 per cent aliquots of each solution using Cs carrier. Both samples gave 2 c/m when measured on the top shelf below the standard thin-window GM counter. The samples had a weight of ~25 mg spread over 2 cm^2. The only other absorber was 0.5 mg/cm^2 of air and 3.5 mg/cm^2 of mica on the tube window. If no appreciable absorption of the β's is assumed, a minimum half-life of 3.5×10^6 years is obtained for Cs^{135}. The sample prepared from the first HNO_3 wash was counted on the low absorption counter (window = 0.2 mg/cm^2) and gave an observed activity of < 6 c/m. If a maximum β energy of 30 Kev is assumed, the minimum half-life of Cs^{135} corresponds to 2.5×10^4 years. These results confirm the work of Finkle and Sugarman who set a minimum half-life of 1200y for Cs^{135} growing from the 6.7h I^{135}, and Glendenin and Metcalf who isolated I soon after a short irradiation of UNH and, from the low activity of Cs found in the I sample, established a lower limit to the half-life of Cs^{135} of 2000y.

*MDDC - 1774-O The Decay Characteristics of 32m Cs^{138}, compiled by J. H. Goldstein, 2 p., n.d., decl. 1/19/48.

The entire text of the paper is reproduced here.

The 32m Cs^{138} has been identified as the daughter of a Xe isotope of 17m half-life. Glasoe and Steigman showed the probable absence of an active descendant and reported a visual range of 1.28 g/cm^2 for the β rays in Al, which corresponds to a β energy of 2.6 Mev. Seelmann-Eggebert showed that the isotopes can be produced by Ba (n,p) from which it is established that the mass assignment is 138.

Evans reported a half-life of 32.9m for a decay through about seven half-lives. This value corroborates the value 32m obtained by Glasoe and Steigman from several excellent decay curves.

Glendenin and Metcalf showed the presence of a hard γ component by following the 32m decay curve through 30 g/cm^2 of Pb. A Pb absorption curve taken on this sample is given. The half thickness is seen to be 11.8 g/cm^2, corresponding to a γ energy of 1.2 Mev.

The fission yield has not yet been determined.

*MDDC - 1774-P Half-Life of Ba^{139}, by C. R. Dillard, H. Finston, and R. M. Adams, 3 p., n.d., decl. 1/19/48.

The half-life of Ba^{139} was found to be 85 ± 0.5m from an analysis of the decay curve of Ba isolated from the solid deposits of the fission gas activities.

Ba^{139} was prepared by sweeping its Xe grandparent out of an irradiated U solution and collecting its Cs parent on a charged wire.

*MDDC - 1774-Q Spectrometer Measurements of the 12.8d Ba^{140} Radiations, by R. Wilkinson and W. Hall, 4 p., n.d., decl. 1/19/48.

Examination of the 12.8d Ba^{140} radiations with a magnetic lens spectrometer has indicated a maximum β energy of 1.05 $\pm$0.05 Mev and a conversion line at 0.54 $\pm$.01 Mev.

*MDDC - 1774-R Discovery of the Chain 1.8h-4.7h Pr in U Fission, by N. E. Ballou, 9 p., n.d., decl. 1/19/48.

A search was made for prominent rare earth fission products of half-lives of the order of 1-20h. In this search an activity of apparent half-life of ~3h was discovered in the Ce fraction. It was established that a 4.7h Pr grows in this Ce fraction and that the half-life of the Ce isotope is about 1.8h. A Ce-free rare earth fraction was subjected to La-Pr separation, and the 5h activity found in this fraction was shown to be largely due to the 4.7h Pr.

*MDDC - 1774-S The Radiations of the 4.7h $Pr^{(145)}$, by S. Katcoff, 4 p., n.d., decl. 1/19/48.

The maximum β energy of the 4.7h $Pr^{(145)}$ found from Al absorption measurements is 3.2 Mev. The β/γ ratio observed when the γ radiation was counted through 1.9 gm Pb/cm^2 was $\sim$2000, indicating the absence of hard γ radiations in high intensity.

*MDDC - 1774-T Characteristics of the 33h Ce^{143}, compiled by J. H. Goldstein, 5 p., n.d., decl. 1/19/48.

The 33h Ce, first isolated from the fission products by Sugarman and Ballou, has been identified as C Ce^{143}. The β component of the 33h Ce has a feather range of 590 mg/cm^2 in Al, corresponding to an energy of 1.36 Mev. A γ component has also been observed, with a half-thickness in Pb of 5 g/cm^2, corresponding to an energy of 0.5 Mev. The parent of the 33h Ce is the 19m La^{143}, and its daughter is the 14d Pr^{143}.

*MDDC - 1774-U The Fission Yield of the 33h Ce^{143}, by S. Katcoff, B. Finkle, and N. Sugarman, 1 p., n.d., decl. 1/19/48.

The entire document is presented here.

The fission yield of the 33h Ce^{143} in bombarded U^{235} has been examined in a comparative study, using a new value of 6.1 per cent for the yield of the 12.8d Ba activity as the standard.

Cerium was isolated from a solution of bombarded uranium nitrate, and its decay curve extrapolated to the end of the bombardment, after subtracting the activities of the 13.5d Pr daughter and of the 28d Ce. Corrections were applied for absorption, chemical yield and parent half-life, and the fission yield was calculated from the following formula:

$$Y = \frac{A^{O} \times T_{\frac{1}{2}}}{A^{O}_{Ba} \times T_{\frac{1}{2}}{}_{Ba}} \times Y_{Ba}$$

where Y is the yield, $T_{\frac{1}{2}}$ the half-life and A^{O} the corrected activity. The fission yield of the 33h Ce was found to be 5.4 per cent.

*MDDC - 1774-V The Ce and Pr Activities of Masses 141 and 143, by N. E. Ballou and W. H. Burgus, 10 p., n.d., decl. 1/19/48.

Neutron irradiation of Ce was found to give two Ce periods of 33h and 28d. The former has a maximum β energy of 1.36 Mev and a γ of 0.5 Mev; the latter has a maximum β energy of 0.60 Mev and a γ of 0.21 Mev.

Praseodymium extractions were made from fission product Ce and from neutron-irradiated Ce, and in both cases an activity of 12-14d half-life was found. This was shown to be the daughter of 33h Ce.

From the ratio of activities of 33h to 28d period with both slow- and fast-neutron bombardments of Ce, the mass assignments 141 and 143 could be made to 28d and 33h Ce, respectively.

*MDDC - 1774-W The Identification and Characterization of 4.5y Element 61^{147}, by J. A. Marinsky and L. E. Glendenin, 11 p., n.d., decl. 1/19/48.

A detailed study has been made of the long-lived isotope of element 61 which occurs in fission.

The separation and identification of this activity as an isotope of element 61 was achieved by the amberlite resin adsorption-elution method. Its decay is characterized by a 0.20 Mev β; no γ is observed. A parent-daughter relationship has been shown to exist between the 11.0 $\pm$ 0.3d Nd and the long-lived element 61. The fission yield of this chain is 3.0 $\pm$ 0.3 per cent, and a mass of 147 has been assigned by the mass spectrograph. The half-life of the long-lived element 61 activity has been calculated to be 5.7y from its observed growth from 11d Nd and 4.4y from the amount of the activity formed in fission (using the fission yield of its 11d Nd parent).

*MDDC - 1774-X The Discovery, Identification and Characterization of 47h Element $61^{(149)}$, by J. A. Marinsky and L. E. Glendenin, 9 p., n.d., decl. 1/19/48.

Identification of a 47h rare-earth activity as an isotope of element 61 has been achieved by ion-exchange studies of neutron-irradiated Nd. This activity has also been discovered in U fission. The half-life of this isotope is 47 $\pm$ 1h, and its decay is characterized by a 1.1 Mev β, a 0.25 Mev γ in low intensity and probably an X-ray of $\sim$40 Kev energy. The fission yield of 47h element 61 is 1.4 $\pm$ 0.1 per cent, and its probable mass assignment is 149.

*MDDC - 1774-Y Study of the 60m $Eu^{(158)}$ and 15.4h $Eu^{(157)}$ Activities in Fission, by L. Winsberg, 10 p., n.d., decl. 1/19/48.

Two short-lived Eu isotopes have been found in fission by a rapid separation of Eu from bombarded UNH. The half-lives found for these activities were 60m and 15.4h. The radiation characteristics of the 60m Eu are: β, 2.5 ± 0.5 Mev; γ, its fission yield in U^{235} is 0.002 per cent. The radiation characterisitcs of the 15.4h Eu are: β's, 1.0 Mev (75 per cent), ~1.8 Mev (25 per cent); γ's, 0.6 Mev and 0.2 Mev, both occurring in 75 per cent of the total β disintegrations. The fission yield in U^{235} is 0.0074 per cent. The tentative mass assignments of 158 for 60m Eu and 157 for 15.4h Eu are suggested by the fission yield curve of U.

*MDDC - 1774-Z Study of the Chain 10h $Sm^{(156)}$ - 15.4d Eu^{156} in Fission, by L. Winsberg, 9 p., n.d., decl. 1/19/48.

The 15.4d $Eu^{(156)}$ found in fission material decays by 0.5 Mev β, 2.5 Mev β and 2.0 Mev γ radiations. Its fission yield in U^{235} is 0.013 per cent. The parent is a ~10h Sm decaying by 0.9 Mev β radiations.

*MDDC - 1774-AA Study of the 2y Eu^{155} in Fission, by L. Winsberg, 6 p., n.d., decl. 1/19/48.

A 2y Eu isotope of mass 155 has been found in fission decaying by means of a 0.2 Mev β and a 0.08 Mev γ. Its fission yield in U^{235} is $\sim$0.03 per cent.

A Europium analysis was made on an ether-extracted solution from a portion of a Clinton slug which had been irradiated for 11 days. The decay of this sample (the 15.4d Eu no longer being present) was followed for nearly a year and a half on the electroscope. Several weaker samples were also counted with thin window GM tubes through various absorbers. On the basis of these several samples, a half-life of 2.0 ± 0.2y is indicated for the long-lived fission Eu.

*MDDC - 1775 Plutonium Project Record, Volume IX-B, Papers from Chapters 9, 11, and 12, edited by N. Sugarman, Argonne National Laboratory, 91 p., n.d., decl. 1/19/48.

To be included in the NNES(MPTS), and to be used in lectures and seminars.

This report is made up of a series of papers numbered MDDC-1775-A through MDDC-1775-J. These papers are individually abstracted below:

*MDDC - 1775-A The Theory of Removal of Noble Gases from Solutions with Carrier Gases, by R. Livingston, E. Shapiro, and N. Elliott, 11 p., n.d., decl. 1/19/48.

The sweeping of a volatile radioisotope from solution by bubbling an inert carrier gas through the solution can be described by equations derived from Fick's law of diffusion. Equations are obtained, first for the steady state concentration of radioisotope remaining in solution when the radioisotope is being replenished at a constant rate, and second for the depletion of the radioisotope from an initially known concentration.

An experiment is described where a measurement is made of the depletion of dissolved tracer Xe from solution by bubbles of He. The depletion is exponential with time in agreement with the theoretical equations. A rough value of D/x, diffusion constant divided by effective film thickness, calculated with the theoretical equations, is in agreement with an estimate from independent calculations.

*MDDC - 1775-B Separation Order of Elution of Rare Earths from Amberlite IR-1 with Five Per Cent Ammonium Citrate, by J. A. Marinsky, 5 p., n.d., decl. 1/19/48.

A study has been made of the amberlite resin adsorption-elution method for separating rare-earth elements. The order of elution of the lighter rare earths has been shown to be that of decreasing atomic number except that Y behaves like a rare earth in the Gd region. This method effects a separation among these rare earths not previously obtainable.

*MDDC - 1775-C Absorption Study of the Radiation Characteristics of 6.8d U^{237}, by E. L Brady and W. Rubinson, 8 p., n.d., decl. 1/19/48.

An Al absorption curve of the radiations of U^{237} over the range 0.2 to 1700 mg/Al/cm^2 has been resolved into four components: a γ (or X-ray) background and three β components of Feather ranges 660, 60, and 22 mg Al/cm^2, corresponding to energies of 1.5, 0.25, and 0.12 Mev.

The half-life of U^{237} has been found to be 6.8 ± 0.1d. A Pb absorption curve has been resolved into three components of half-thicknesses 4.8, 0.78, and 0.26 g Pb/cm^2 corresponding to γ energies of 0.53, 0.23, and 0.14 Mev.

The significance of all the β and γ components has not been elucidated. A decay mechanism could not even be tentatively proposed at this time.

*MDDC - 1775-D Chemical Identification of the 8s Activity Found in Pile-Irradiated Oxygen Compounds, by T. B. Novey, J. D. Knight, D. S. Schover, and N. Elliott, 7 p., n.d., decl. 1/19/48.

Chemical separations have established that the 8s activity produced in oxygen compounds irradiated in the Clinton pile is to be ascribed to nitrogen. Potassium nitrite was irradiated for twenty seconds and dropped quickly into a hot acidified hydrazine solution. The separation and transfer to a counting chamber around a GM tube was completed 7 seconds after the end of the irradiation. It was thus shown that the reaction $O^{16}(n,p)N^{16}$, with 9.5 Mev threshold, occurs with pile neutrons.

*MDDC - 1775-E The Half-Life and Radiations of Se^{75}, by H. Gest and L. E. Glendenin 11 p, n.d., decl. 1/19/48.

Se^{75} has been produced by neutron irradiation of Se in the Clinton pile. This isotope decays by K-electron capture with the emission of 0.18 Mev and 0.35 Mev γ radiation, 10.5 Kev X-rays and conversion electrons with a half-thickness of $\sim$3 mg/cm^2 in Al. The half-life is 125 $\pm$ 5d, and the pile neutron cross section is 26 barns per atom of Se^{74}.

*MDDC - 1775-F The Half-Life and Radiations of Cs^{134}, by L. E. Glendenin, 6 p., n.d., decl. 1/19/48.

The long-lived Cs^{134} has been produced by neutron irradiation of Cs^{133} (100 per cent isotopic abundance) in the Clinton Pile, and its half-life and radiations have been investigated. In 1940, Kalbfell and Cooley prepared this activity by n, γ and d,p reactions on Cs and reported a β energy of 0.9 Mev by absorption measurements, the presence of γ radiation and a half-life of 1.7y. In the present work two γ rays of 0.8 Mev energy and β radiation of 0.75 Mev maximum energy were observed. The half-life observed over a period of about a year is 2.3 $\pm$ 0.3y.

*MDDC - 1775-G Discovery of a 5.9d Rh Activity in Deuteron-Bombarded Ru, by W. H. Sullivan, N. R. Sleight, and E. M. Gladrow, 5 p., n.d., decl. 1/19/48.

In Rhenium isolated from deuteron-bombarded Ruthenium a weak 5.9h Rh activity was found. It appeared to have no β or γ radiations other than a very soft electron component with a 5 mg/cm^2 Al half-value thickness. It was postulated that the activity decayed by orbital electron capture with almost complete conversion of a soft γ ray, From the Bohr-Wheeler calculations and other considerations, the mass assignment was postulated to be Rh^{101}.

*MDDC - 1775-H Discovery and Characterization of a 21h Rh Activity in Deuteron-Bombarded Ru, by W. H. Sullivan, N. R. Sleight, and E. M. Gladrow, 6 p., n.d., decl. 1/19/48.

In Rhenium isolated from Ruthenium bombarded with deuterons, a 21h activity, emitting only hard γ rays (1.8Mev) and X-rays (19.3 Kev), was discovered. The decay mechanism was postulated to be orbital electron capture, and the mass assignment was predicted to be 100, as based on Bohr-Wheeler calculations and considerations of the nuclear reaction and isotopes involved.

*MDDC - 1775-I Discovery, Characterization and Mass Assignment of a 2.8d Ru Activity, by W. H. Sullivan, N. R. Sleight, and E. M. Gladrow, 8 p., n.d., decl. 1/19/48.

In Ru irradiated with neutrons and deuterons, a 2.8d Ru activity was observed. Correlative data on activation and radiation characteristics of the 2.8d and 42d Ru isotopes led to mass assignments of 97 and 103, respectively. Radiations emitted by the 2.8d activity include a 0.23 Mev γ ray, an 18 Kev X-ray and soft electrons of 50-70 mg/cm^2. Al range (0.2 Mev). From all considerations, it was concluded that the most probable decay mechanism is K electron capture.

*MDDC - 1775-J A Study of Sm and Eu Activities Induced by Deuteron and Neutron Irradiation of Sm, by J. A. Marinsky and L. E. Glendenin, 24 p., n.d., decl. 1/19/48.

A study of activities induced by bombardment of Sm with high-energy deuterons and pile neutrons has been made. The activities observed in the deuteron-irradiated Sm are identified as isotopes of Eu by the amberlite resin adsorption-elution method, and no long-lifed Sm is observed. Neutron bombardment of Sm also failed to produce any observable long-lived Sm activity.

In the course of these experiments four Eu activities, two with long half-lives, the third with a $\sim$14d half-life and the fourth with a $\sim$53d half-life, were observed and assigned to Eu^{154} Eu^{155}, $Eu^{(149)}$, and $Eu^{(147)}$, respectively. The long-lived isotopes were identified with the known 5-8y Eu^{154} and 2y Eu^{155}. The $\sim$14d and $\sim$53d isotopes were tentatively assigned masses of 149 and 147 on the basis of energy.

The radiation characteristics of these active Eu isotopes were measured, and decay schemes were proposed for 5-8y Eu^{154} and $\sim$53d $Eu^{(147)}$.

*MDDC - 1776 Packing Fraction Measurements of the Heavy Elements, by A. J. Dempster, 1 p., February 12, 1948. (ANL-AJD-231).

For oral presentation before a meeting of the American Physical Society to be held April 29, 1948, and for publication in the Bulletin of the American Physical Society.

The entire text of the original abstract is presented here.

The resolving power of the double-focussing mass spectrograph previously used for comparing the masses of the isotopes of the heavy elements has been increased about ten times. The spark source previously used has been replaced with electron ionization by 1000 volt electrons of the vapors of the metal or volatile metallic compounds. Ions with high multiple charges are produced with sufficient intensity in this manner. (A. E. Shaw, Physical Review, March 1948). The electrode arrangement for accelerating and focussing the ions as developed by A. O. Nier (Review of Scientific Instruments, 18, p. 398, 1947) has been adapted for use with 15,000 volt accelerating potentials. The resolution obtained will be illustrated by photographs of the mass spectra of zinc showing $^{64}Zn^{+4}$, O^+, NH_2^+ and CH_4^+ at mass 16, and $^{68}Zn^{+4}$, OH^+ and NH_3^+ at mass 17, from which mass values for the zinc isotopes of 63.953 and 67.951 may be deduced.

MDDC - 1777 The Quantitative Spectrographic Analysis of the Rare Earths Elements, III. Determination of Major Constituents in Complex Mixtures, by V. A. Fassel and H. A. Wilhelm, 15 p., n.d., decl. 3/3/48.

For oral presentation before the annual meeting of the Optical Society of America held March 6, 1948, and for publication in the Journal of the Optical Society of America.

See MDDC - 1512

Spectrographic methods applicable to the determination of major rare earth constituents in complex mixtures are described. The specific examples discussed are the determination of yttrium and gadolinium in the concentration range of 10 to 100 per cent. The procedure involves the high current d-c arc excitation of rare earth oxide sample-ceric oxide-graphite mixtures. Selected lines of cerium are used as internal standards. The choice of cerium as internal standard was based on the relative ease with which any cerium present in a mixture could be preferentially separated from the mixture and then reintroduced in a standard amount. Precision data indicate a standard deviation of about ±3 per cent of the amount present.

MDDC - 1778 The Metabolism of Carrier-Free Radioactive Silver in the Rat, by K. G. Scott, 46 p., January 1, 1948. (UCRL- 36).

For use as a thesis, and also to be submitted for publication in a medical journal.

The manner in which rats handle small amounts of silver is different from the findings reported on argyrism. After the administration of about 10^{13} atoms of silver, excretion is immediately and thoroughly accomplished. This is done principally by the liver. Owing to lack of absorption from the intestinal tract, the silver is found in the fecal contents. Silver administered by stomach tube was not absorbed within the limits of the sensitivity of the method but was less than 0.1% in these studies. The distribution of silver in the rat after intravenous injection is the same as that observed after intramuscular injection. When the dose of silver atoms per rat was increased from 10^{13} to 10^{18}, which is a concentration commonly used in therapy, a quite different distribution of the silver in the body was obtained. This was apparently due to the inability of the liver to excrete this larger amount of silver with the efficiency it demonstrated with smaller doses. Because of this there was observed a 10 to 100 fold increase in the concentration of silver observed in such organs as liver, kidney, spleen, skin, bone, and muscle. The deposition in these tissues was proportional to the total amount of silver administered.

It has been shown that animals whose livers have been damaged with three hours of light chloroform anesthesia are unable to excrete a dose of silver containing as few as 10^{13} atoms efficiently. The reduction in capacity to function in this manner is enormous. It was reduced to a value of about 10^{-4} of normal. The damage is transient with recovery occurring in several days. The distribution of silver in the other tissues of the chloroform treated rats resembles that obtained when doses of silver, larger by a factor of about 10^{4}, are administered. The above results point the way for a development of a liver function test.

If the normal route of excretion of silver is cut off by bile duct ligation, large amounts of silver pile up in the liver and other tissues of the body. Some silver is excreted in the feces after bile duct ligation, suggesting a mechanism secondary to the liver although the rate of excretion is much lower.

Silver atoms in concentrations of about 10^{13} atoms per cc of blood are combined primarily on blood proteins although measureable amounts are found on the red cell membrane and in the hemoglobin. The silver was not dialyzable through cellophane. The primary carrier of silver in the blood is the blood globulin fraction although some is carried on the albumin fraction. The relative distribution of silver on the various fractions of the blood is regulated by the blood itself, since purified globulin containing silver redistributes the silver to the other protein fractions of the blood in vitro when it is added to whole blood.

Silver combined with globulin is rapidly taken from the globulin in the intact animal and excreted by the liver.

*MDDC - 1779 Plutonium Project Record, Volume IX-B, Papers from Chapter 7, edited by N. Sugarman, Argonne National Laboratory, 36 p., n.d., decl. 2/26/48.

To be included in the NNES(MPTS), and for use in lectures and seminars.

This report is made up of a series of papers numbered MDDC - 1779-A through MDDC - 1779-F. These papers are individually abstracted below:

*MDDC - 1779-A Fission Yield of 30h Te^{131}, by S. Katcoff, 3 p., n.d., decl. 2/26/48.

The fission yield of 30h Te was determined to be 0.45 per cent from an analysis of 8.0d I growing from the Te. Since the determination involves a prior clean-up of I from the solution which was probably not complete, the yield reported is probably a maximum value.

•MDDC - 1779-B Characteristics of 6.7h I^{135}, II, by S. Katcoff, et al., 11 p., n.d., decl. 2/26/48.

From experiments using a new chemical procedure for I, the fission yield was found to be 5.6 ± 0.3 per cent. The average half-life obtained from several decay curves through 31 g Pb/cm^2 is 6.7h. The radiations of this isotope are: β, 1.4 Mev, γ, 1.6 Mev.

The results of earlier experiments on the fission yield of 6.7h I^{135} led to values of 4.6 per cent and 2. 6 per cent. The discrepancy arose because of the lack of exchange of the radioisotope and the carrier added to the solution.

•MDDC - 1779-C Characteristics of the 22h I^{133}, compiled by J. H. Goldstein, 2 p., n.d., decl. 2/26/48.

The 22h I is found in fission as the daughter of the 60m Te^{133} and decays to the 5.3d Xe^{133}. The maximum energy of the β-radiation is 1.35 ± 0.1 Mev, and the energy of the γ component is 0.55 Mev.

Fission yields of 4.6 per cent and 5.0 per cent are reported for U and Pu fission, respectively, subject to some uncertainty in completeness of exchange in the former case.

*MDDC - 1779-D Characteristics of 5.3d Xe^{133}, II, by D. W. Engelkemeir and N. Sugarman, 14 p., n.d., decl. 2/26/48.

Only one moderate-lived gaseous activity is present in the irradiated U metal, namely, Xe^{133}. The average value of the half-life found from the analysis of decay curves taken on the GM tube through varying amounts of absorber is 5.5d. The half-life as read off the decay curve of the X- and γ-rays taken on the electroscope is 5.55d. A very long-lived gaseous activity was also found and identified as a Kr activity.

Analysis of Al, Cu, and Pb absorption curves shows the following radiations to be present in Xe^{133}.

0.35 Mev
X-ray (?): $\sim$0.031 Mev
γ-ray: $\sim$0.085 Mev

The presence of the γ-ray in high yield indicates that the conversion is incomplete.

*MDDC - 1779-E The Radiation Characteristics of 33y Cs^{137}, by L. E. Glendenin and R. P. Metcalf, 4 p., n.d., decl. 2/26/48.

Ranges were obtained of 320 mg/cm^2 and 155 mg/cm^2 for the β components by Feather analysis of several Al absorption curves, corresponding to energies of 0.8 and 0.5 Mev in approximately equal intensities. A half-thickness of 7.5 gm/cm^2 of Pb was obtained for the γ component from three absorption curves, corresponding to an energy of 0.75 Mev. Typical absorption curves from which these determinations were made are reproduced.

*MDDC - 1779-F The Estimation of the Half-Life of the 33y Cs^{137}, compiled by J.H. Goldstein, 2 p., n.d., decl. 2/26/48.

The best present value of the half-life of Cs^{137} is regarded as 33 ± 3 years. It is based on a number of determinations.

*AECD - 1780 Uranium Tetrachloride - Two One-Year Inhalation Toxicity Studies of Animals at 0.2 and 0.05 mg U/m^3, by N. J. Ashenburg, 55 p., January 1948.

To be included in the NNES(MPTS).

In conformity with other studies of chronic inhalation toxicity from uranium dust, animals were exposed daily for one year to UCl_4 distributed in an atmosphere equivalent to concentrations of 0.05 mg and 0.2 mg U/m^3, for the purpose of determining "borderline" or safe levels of exposure for the duration of one year. At the 0.05 mg level, 21 dogs and 150 rats were exposed; at the 0.2 mg level, the same numbers of these two species were exposed, and, in addition, 20 rabbits and 30 guinea pigs. The customary period of one month prior to exposure was employed for acclimatizing the animals to chamber conditions and for the collection of control toxicologic data. UCl_4 differed from certain other uranium dusts employed in this series in that exposure was complicated by the formation of hydrolytic products, $UOCl_2$, UO_2Cl_2, UO_2, and HCl.

At the end of one year, some renal injury, attributable to uranium exposure, was seen in all species at both levels, but at the 0.05 mg level this was confined to 10% of the dogs and to 6% of the rats and was from slight to moderate in degree. At the 0.2 mg level, 50% of all dogs and 9% of the rats showed mild renal injury; rabbits showed 20% (2 of 10) and guinea pigs 10% (1 of 10). Injury was, for the most part, chronic in nature as seen in repeated serial histologic examination and as confirmed in a few instances by changes in certain biochemical criteria. There was evidence from bromsulfalein dye retention studies of possible liver injury in dogs at the higher level, although no histologic evidence for this was seen. There were changes of possible significance in the hemoglobin and reticulocyte count of rats, but not in dogs. No appreciable accumulation of uranium occurred at either level in the tissues of any species.

*AECD - 1781 Activation Cross Sections by Boron Absorption, by S. M. Dancoff, et al., 34 p., n.d., decl. 3/1/48. (ANL-HDY-284).

For publication in Physical Review.

Using a beam of neutrons from the heavy water pile, and inserting increasing thicknesses of boron absorbers enriched in B^{10}, the activation cross sections of various elements in the range 10-20,000 ev were studied. Resonances were observed for sodium, aluminum, chlorine, vanadium, manganese, and copper. It is indicated that these resonances show scattering which predominates over absorption. In the case of manganese a strong level at 260 ev is observed, whose properties can be correlated in a reasonable way with the thermal cross sections of manganese by the use of the Breit-Wigner one-level formula.

*AECD - 1782 Methods for the Complete Decomposition of Rock and Ore Samples to Be Analyzed for Very Small Amounts of Uranium and Thorium, by M. D. Foster, et al., 7 p., n.d., decl. 3/8/48.

To be included in the NNES(MPTS).

This paper presents the methods used in the Chemical Laboratory of the Geological Survey for the decomposition of samples to be analyzed for very small amounts of uranium and thorium. It is

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desirable to have a general method applicable to most types of rocks and ores without modification, although it is evident that some samples will require special treatment. Complete decomposition of the sample is essential, as uranium and thorium may be present in some of the most refractory minerals such as zircon, microlite, and monazite.

The samples are decomposed by means of volatile acids whenever possible, nitric and hydrofluoric acids being used for the initial treatment. The HF is removed by repeated evaporations with nitric acid, which is then removed by evaporations with HCl. HF can be removed more readily by fuming with sulfuric or perchloric acid, but both reagents are undesirable. Many samples, such as phosphate rock and limestone, have high calcium contents and the greater part of the calcium precipitates out as sulfate. Perchloric acid is avoided because the presence of perchlorates sometimes leads to the formation of rather stable emulsions during the extractions with organic solvents (such as ethyl acetate) in the analytical procedures.

In the special procedure for refractory minerals, decomposition is effected by fusion with sodium peroxide.

AECD - 1783 Characteristics of Bismuth Fission with High Energy Particles, by R. H. Goeckermann and I. Perlman, 4 p., n.d., decl. 3/3/48. (UCRL-42).

For publication as a Letter to the Editor of Physical Review.

The fission yields for 25 of the long-lived products from the fission of bismuth with 200-Mev deuterons have been determined. The types of fission products and yields fit in with the theory that 10 or 12 neutrons are boiled out of the target nucleus before fission takes place and that the nucleus which undergoes fission does so maintaining the same neutron to proton ratio in the two fragments.

The following is a list of bismuth fission products which were identified: Ca^{45}, Fe^{59}, Ni^{66}, Cu^{67}, Zn^{72}, As^{74}, As^{77}, Rb^{86}, Sr^{89}, Y^{90}, Y^{91}, Zr^{95}, Mo^{99}, Ru^{103}, Ru^{106}, Ag^{111}, Pd^{112}, Cd^{115} (44 days), Te^{119}, Sb^{122}, I^{124}, I^{125}, I^{126}, Ba^{133}, Ce^{139}.

AECD - 1784 Properties of 86s $I^{(136)}$, by S. Katcoff and C. W. Stanley, 15 p., n.d., decl. 2/24/48. (LADC-402).

For publication in Physical Review.

A short-lived iodine which was discovered by Strassmann and Hahn as a U fission product was shown to have a half-life of 86 ± 1 second. It emits 6.5-Mev β-rays and 2.9-Mev γ-rays. The fission yields in U^{235}, Pu^{239}, and U^{233} are 2.3%, 1.1%, and 1.1%, respectively. A mass assignment to 136 has been shown to the most likely one. The observed 86s I activity cannot originate from a Te parent whose half-life is greater than 20s.

The uranium or plutonium was irradiated, in solution, at the center of the homogeneous pile (water boiler) at Los Alamos for periods of two or three minutes. Carrier was added and iodine was then extracted by the radiochemical method of Glendenin and Metcalf.

AECD - 1785 The Metabolism of Americium in the Rat, by K. G. Scott, D. H. Copp, D. Axelrod, and J. G. Hamilton, 17 p., December 15, 1947. (UCRL-22).

Informal disposition and for publication in a technical journal.

An investigation of the metabolism of americium (element 95) in the rat has been conducted following its administration by intramuscular injection and by stomach tube. Each animal received .3 micrograms of $AmCl_3$ in 1 cc of isotonic saline at pH 5. No appreciable absorption took place from the digestive tract. Within 24 hours after parenteral administration, 55 % of the total amount of americium absorbed from the site of injection was deposited in the liver and 20% was accumulated by the skeleton. Excretion occurred primarily by way of the digestive tract and most of the americium eliminated appeared to come from the liver, which released this element at an almost exponential rate for 30 days with a half-time of 10 days. Thereafter, excretion became progressively slower. There was no significant change in the content of americium in the skeleton throughout the entire interval of the experiments, which extended for 256 days. The only other tissues studied that demonstrated any striking degree of accumulation of americium were the kidneys and spleen. The distribution of americium in the bone was studied by means of the radioautographic technique and it was observed that deposition of this element occurred in the region of the osteoid matrix and about the small blood vessels of the cortex.

*AECD - 1786 Hyperfine Structure in the Spectrum of Np^{237}, by F. S. Tompkins, 1 p., February 1948. (ANL-JJK-14B-118).

For publication in Physical Review.

The entire document is presented here.

In the course of numerous routine spectrographic analyses of very small samples of Np^{237} it was observed that many of the neptunium lines appeared very broad, even under moderate dispersion (5 A/mm), suggesting the presence of wide hyperfine structure. The widest neptunium line in the region investigated, at 3829.15A, was then photographed using the third order of a Baird three-meter grating spectrograph (dispersion = 1.7 A/mm), with the result that this line was shown to be a flag-pattern type hypermultiplet in which the first three components were resolved.

Larger samples of the isotope have become available and the spectrum has been investigated in some detail using a Fabry-Perot interferometer. The source used was a water-cooled Schuler type hollow cathode tube, and the spectrograph was a Bausch and Lomb large littrow type with glass optics. Under high resolving power all lines exhibiting hyperfine structure appear as flag patterns, some degraded in spacing and intensities toward the red and the others toward the violet. Approximately fifty of these lines have been completely resolved; in each case into six components. This is strong evidence that this is a case analogous to that found in praseodymium where every line showing hyperfine structure which can be resolved to shown to consist of six components.

For neptunium, as in the case of praseodymium, this can be interpreted only to mean that for each of the widely split spectral terms involved, J is greater than I and, consequently, the number of hyperfine levels into which the term is split is equal to $2I + 1$. Thus it appears that for Np^{237}, $I = 5/2$.

This work will be published in detail in the near future.

*AECD - 1787 Crystal Structure Studies of Oxides of Plutonium, by R. C. L. Mooney and W. H. Zachariasen, 8 p., July 1946. (ANL-JJK-14B-71).

To be included in the NNES(MPTS).

PuO_2 has the fluorite type of structure with a = 5.386 ± 0.001 A and a calculated density of ρ = 11.44 ± 0.01.

Another plutonium oxide phase is identified as Pu_2O_3 with some excess oxygen corresponding to a composition in the range Pu_2O_3 - Pu_4O_7. This phase is cubic body-centered with a = 11.01 ± 0.01A and 32 plutonium atoms per unit cell. The structure is similar to that of the C-modification of the rare earth sesqui-oxides.

A sub-oxide of plutonium is identified as PuO. It has the NaCl-type of structure with a = 4.948 ± 0.002A and a calculated density of ρ = 13.89 ± 0.02.

Some X-ray data for two plutonium peroxides are given. One of these peroxides gives an X-ray diffraction pattern corresponding to a two-dimensional hexagonal lattice with a_1 = 4.00 ± 0.02A. The other peroxide is cubic face-centered with a = 16.5 ± 0.1A.

*AECD - 1788 Preparation and Properties of Some Plutonium Sulfides and Oxysulfides, by B. M. Abraham, N. R. Davidson, and E. F. Westrum, Jr., 7 p., n.d., decl. 7/23/47. (ANL-JJK-14B-49).

To be included in the NNES(MPTS).

At about 1225°-1300°C PuO_2 in a graphite crucible reacts with H_2S to form Pu_2O_2S. A prolonged treatment of PuO_2 in a graphite crucible with H_2S at 1340°-1400°C gave rise to Pu_2S_3. It is also possible to prepare Pu_2S_3 from $PuCl_3$ and H_2S at 900°C; however, the X-ray diffraction pattern of the Pu_2S_3 prepared by the second method differs from that prepared from PuO_2 and H_2S. A substance believed to be impure PuS was obtained in a reduction of PuF_3 with calcium metal in a barium sulfide crucible.

AECD - 1789 Operation Manual for Rochester Ion Meter and Accessory Chambers, by W. F. Bale, 21 p., May 9, 1945. (II-188-7575).

Disposition as required for use in research, development, or manufacturing work.

See also MDDC-1651.

This instrument is designed for the detection and measurement of a group of ionizing radiations. Interchangeable ionization chambers have been constructed for the measurement of (1) beta and gamma radiations, (2) surface and hand monitoring of alpha radiations, (3) alpha and beta radiation of dust samples collected in precipitron tubes, and (4) fast neutrons.

Moderate to high radiation intensities are measured by direct continuous deflection of a microammeter indicating changes in plate current of a 1LN5 tube used as an electrometer tube. Low intensities of radiation are measured by allowing the charge due to the ionization current to collect on one plate of

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a condenser. The other plate connects to the grid of the electrometer tube and to ground through a high resistance. During the period of charge collection the two condenser plates are electrically shielded from one another by a grounded metal vane inserted between them. On removing this vane the charge on the first plate of the condenser is communicated to the second plate and thus to the tube grid. A transient meter deflection then occurs proportional to the product of ionization current and ion collection time.

A two pole, triple throw switch allows the output meter to be connected in test 1 position to measure screen grid current, in test 2 position to set tube voltages to reproducible values, and in operate position to measure changes in plate current.

Circuit diagrams of the ion meter and sketches of alpha surface monitor, neutron chamber, and auxiliary chamber for dust measurements are included.

*AECD - 1790 Methane Proportional Counter for Beta Counting, by C. J. Borkowski and E. Fairstein, 1 p., n.d., decl. 3/8/48.

For oral presentation before a meeting of the American Physical Society to be held in Washington, D. C.

This document is an abstract and is presented here in its entirety.

Counters filled with methane and operated in the proportional region with a gas amplification of 10,000 have been developed for precision counting of beta particles, gamma rays, X-rays, and soft conversion electrons.

Plateaus of 400 volts are obtained with a slope of 1% or less per 100 volts. Using 0.5 mil tungsten center wire and methane at one atmosphere, the operating voltage is 2200 volts. With a specially designed chamber similar to the one described by J. A. Simpson and a continuous flow of methane at atmospheric pressure, the counting of soft radiation is made possible without window or air absorption. H^3 beta particles have been counted from solid sources in this type of counter. Counting yields as high as 75% are obtained for beta emitters like C^{14}, S^{35}, P^{32}. These counters have been operated continuously for more than a year with no changes of characteristics.

High speed counting is possible since the coincidence loss is only 1% per 100,000 counts per minute.

Energies of beta particles below 50 kev may be determined with this type counter since the counter is operating in the proportional region.

*AECD - 1791 Preliminary Studies on C^{14} Metabolism of Tissue Cultures, by A. M. Brues, A. Naranjo, and R. R. Newell, 1 p., February 5, 1948. (ANL-HDY-418).

For oral presentation before a meeting of the American Association of Anatomists, and for publication in the Bulletin of the American Association of Anatomists.

This document is an abstract and is presented here in its entirety.

The uptake and retention of carbon^{14} by tissue cultures has been measured using cultures of chick

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embryo tissues grown on 0.2 mil nylon film inserted in roller bottles. Uptake by explants from the medium occurs at a measurable rate only during the first five to ten hours after incubation with medium containing the isotope as bicarbonate. On four successive washings, each followed by a 24-hour incubation, 98 - 99% of the isotopic carbon is removed from cultures which have been incubated with it over a 2-day period, most of which is removed in the first incubation with carbon^{14} free medium.

The residual (fixed) carbon appears to be in various chemical forms, as it is only partly removed by cold trichloracetic acid, alcohol ether, and saturated sodium chloride. Autographs of the explants show that the residual activity is in the tissue.

Explantation of tissues from embryos treated in vivo between the 7th and 10th days of incubation by carbon^{14}-containing bicarbonate show a much greater retention of the isotope (up to 50%). Treatment of the total animal by injection of the same material results in only slight retention after one day (less than 1%). Thus, growing tissue irreversibly fixes a large amount of carbon^{14}, although in non-growing tissue it is largely lost through turnover.

*AECD - 1792 Mitotic Changes Induced in Regenerating Liver, by A, M. Brues and L. Rietz, 1 p., February 5, 1948. (ANL-HDY-419).

For oral presentation before a meeting of the American Association of Anatomists, and for publication in the Bulletin of the American Association of Anatomists.

This document is an abstract and is reproduced here in its entirety.

Photomicrographs of regenerating rat liver after 30r total body X-ray show mitotic changes similar to those characterizing radiation effects for other cell types, including scattering and fragmentation of chromosomes and chromosome bridges. The chromosome bridge appears to be the most unequivocal evidence of radiation-induced change. In livers of animals treated with plutonium^{239}, one sees a much wider range of response by cells in different portions of the organ than with total body X-ray or radiation from P^{32}, and many degenerated cells are seen. This is consistent with the known heterogeneous distribution of plutonium in the liver and with the short-range of the alpha particles with which it emits.

*AECD - 1793 Range of Delayed Neutron Emitting Fission Fragments, by W. M. Good, E. O. Wollan, and W. A. Strauser, 1 p., n.d., decl. 3/9/48.

For oral presentation before a meeting of the American Physical Society, and for publication in the Bulletin of the American Physical Society.

This document is an abstract and is presented here in its entirety.

A study is being made of the range in air and other gases of the fission fragments which are responsible for the 4.5 sec, 22 sec and 55 sec delayed neutron activities. The apparatus consists of a special gas tight chamber ("rabbit") which contains a fission foil, a collector button, a gas sealing button and a filling valve. This rabbit is sent in and out of the Clinton pile in a pneumatic tube and the catcher button is automatically removed from the assembly on exit from the pile and sent into a counter

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assembly where the delayed neutron activity is counted as a function of time after irradiation and of the gas pressure in the rabbit. The apparatus will be described in detail. To date results have been obtained on the range in air of the above mentioned fission fragments from both U^{235} and U^{233}. These results are listed in the following table:

	4.5 sec.	22 sec.	55 sec.
235	3.13 ± .03 mg/cm^2 air	2.33 ± .02	3.19 ± .03
233	3.16 ± .03	2.33 ± .02	3.16 ± .03

AECD - 1794 Conversion of Carbon Dioxide to Methane for Counting C^{14}, by G. R. Hennig, 5 p., December 9, 1947. (ANL-4080).

For publication in Science.

Very low concentrations of C^{14} can be most conveniently determined in large internal counters if the carbon can be converted to a suitable counting gas.

According to Fischer and co-workers, various catalyst mixtures containing nickel will convert a mixture of hydrogen and carbon dioxide completely to methane at 400°C. In their last paper, ruthenium metal was claimed to be active at 150°C. These results are confirmed in the present investigation.

The application of this method to internal counting of low concentrations of C^{14} is discussed.

*AECD - 1795 Ranges in Air and Mass Identification of Plutonium Fission Fragments, by S. Katcoff, 1 p., n.d., decl. 3/9/48. (LADC-495).

For publication in the Bulletin of the American Physical Society.

See also MDDC-812.

This document is an abstract, and the entire text is reproduced here.

Determinations were made of the mean and extrapolated ranges in air of plutonium fission fragments for twenty individual masses between 83 and 157. Collimated fission fragments passing through air at 120 or 140 mm pressure were deposited, after being stopped by the air, on a series of fourteen thin lacquer films. These were analyzed radiochemically for individual fission products. The corrected activities were plotted against distance traversed by the fragments, yielding differential range curves whose widths at half minimum were 11.7 ± 1.3 per cent, independent of fragment mass. The activities found beyond each distance were plotted against distance giving integral range curves. Mean and extrapolated ranges were derived from these. In the light group the extrapolated ranges decrease from 2.90 cm (15°C and 760 mm) for mass 83, to 2.25 cm for mass 117; in the heavy group they decrease from 2.25 cm for mass 127, to 1.95 cm for mass 157. From the range-mass curve drawn for well-known masses, definite assignments of 92, 93, and 132 were given to 3.5h Y, 10h Y, and 77h Te, respectively. Highly probable assignments of 94 and 134 were given to 20m Y and 54m I, respectively.

*AECD - 1796 Model 4 Sweep, by E. W. Titterton, 1 p., May 19, 1945. (LADC-364).

Disposition as required for use in research, development, or manufacturing work. This includes the declassification of the model 4 sweep.

A diagram of an oscilloscope sweep circuit is detailed; triggered from an input, proportional counter pulse.

*AECD - 1797 Characteristics of an Acoustic Interferometer, by N. Underwood, 1 p., February 6, 1948.

For oral presentation before a meeting of the Southeastern Section of the American Physical Society, and for publication in the Bulletin of the American Physical Society.

This document is an abstract and is presented here in its entirety.

A quartz crystal which sets up vibrations in the liquid is driven by the beat frequency between two other crystal controlled oscillators as devised by McMillan and Lagemann. A reflector is moved down through the liquid by means of a micrometer screw. Each time the reflector is at a nodal point, mechanical resonance occurs. This reacts on the crystal and results in a voltage drop of about 5%. Spurious nodal points sometimes appear. This may be remedied in three ways: (1) improve the stability of the acoustic coupling between the crystal and the liquid by driving through a wave plate (thickness equal to the sonic wavelength in the material), (2) keep the liquid surface non-parallel to the plane of the bottom, (3) slope the back surface of the reflector or make it a wavelength in thickness. One of the advantages of the oscillator drive of McMillan and Lagemann is its great stability and insensitiveness to changing experimental conditions. The pressure on the interferometer crystal was varied from 6 plus or minus 2 gmf to 6000 plus or minus 20 gmf, without changing the voltage dips in shape or absolute magnitude in a detectable manner.

AECD - 1798 The Crystal Structure of Na_3UF_7, by W. H. Zachariasen, 6 p., January 15, 1948. (ANL-4101).

For publication in the Acta Crystallographica or a similar technical journal.

The compound Na_3UF_7 is tetragonal with two molecules per unit cell. The lattice dimensions are: $a_1 = 5.448$ A, $a_3 = 10.896$ A. The space group is 14/mm and the atomic positions are (0 0 0) $(\frac{1}{2}\frac{1}{2}\frac{1}{2})$ + 2 U in (0 0 0), 2 Na in (0 0 $\frac{1}{2}$), 4 Na in $(\frac{1}{2}0\frac{1}{4})$ $(0\ \frac{1}{2}\ \frac{1}{4})$, 14 F in $\pm$ (u u v) $(\bar{u}\ \bar{u}$ v) (u $\bar{u}$ v) ($\bar{u}$ u v), with $u = \frac{1}{4}$ and v = 1/8. Each metal atom is bonded to seven fluorine atoms at the corners of a cube with Na-F = U-F = 2.36 A. The wide homogeneity range of the phase is explained in terms of the crystal structure.

*AECD - 1799 Effect of Slow Neutrons from the Oak Ridge Pile on Tradescantia Chromosomes, by A. D. Conger and N. H. Giles, Jr., 1 p., n.d., decl. 3/9/48.

For oral presentation before a meeting of the Association of Southeastern Biologists to be held in April 1948.

This document is an abstract and is presented here in its entirety.

Tradescantia inflorescences were exposed to the essentially pure slow neutron beam from the thermal column of the Oak Ridge graphite pile, and the frequency of the chromosomal aberrations induced was plotted against the neutron dose (in neutrons per square centimeter).

Chromosome aberrations of the "two hit" type, which require the occurrence of two independent breaks of the chromosomes in their formation, seem to vary linearly with increase in slow neutron dose. Previous work has shown that with X- and gamma rays these aberrations vary as the square of the dose, while with radiation of heavy particles such as fast neutrons and alpha particles the aberrations vary linearly with dose. This would indicate that most of the slow neutron effect observed is due to a capture reaction followed by the emission of a heavy particle. In biological material, nitrogen is the most abundant element with a high neutron capture cross section which emits a heavy particle after slow neutron capture; it is probably this $N^{14}(n,p)C^{14}$ reaction, rather than the more numerous (n, gamma) reactions of other elements, which is responsible for most of the cytogenetic effect of slow neutrons.

AECD - 1800 The Preparation of Very Thin Plastic Films, by L. M. Fry and R. T. Overman, 6 p., January 30, 1948. (CNL-20).

Disposition as required for use in research, development, and manufacturing work.

Tough plastic films, weighing as little as 50 $\mu g/cm^2$, can be made by dropping a plastic solution on the surface of water or by covering a glass plate with the solution. Laminated films can be made, combining the qualities of two or more plastics. Properties and techniques of preparation of such films are discussed. Plastic materials investigated are Formvar E, Zapon, and polystyrene.

The films have been used as counter windows in continuous alpha-counting processes, and as mountings for radioactive sources in absolute beta counting, in fission counting, and in beta-ray spectrometer work. There is very little backscattering due to these films, and essentially all fission fragments and alpha particles pass through them.

AECD - 1801 Polarographic Studies of the Uranyl-Citrate Complex, by W. F. Neuman and J. R. Havill, 19 p., January 1948. (UR-3).

To be included in the NNES(MPTS) and for publication in the Journal of the American Chemical Society.

Citrate forms a soluble, complex ion, combining with uranium in a mole ratio of one. The complex probably exists in solution as a dimer with very little tendency to dissociate. It is stable over a wide range of pH. From the negativity of the half-wave potential, it appears unlikely that uranyl-citrate would be reduced in vivo.

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An automatic recording polarograph was used and a saturated calomel electrode, connected to the electrolysis cell by means of a saturated KCl salt-bridge, served as an anode. All polarograms were obtained at room temperature, approximately 25°C.

The polarographic results suggest that even small quantities of citrate formed by the kidney would compete effectively with other agents for urinary uranium. Since the U_6-citrate complex has been shown not to be inhibitory to enzymes or harmful to protein, the polarographic results lend support to the hypothesis that urinary citrate may be a physiological mechanism for the detoxication and excretion of uranium.

*AECD - 1802 Scintillation Counting with Anthracene, by P. R. Bell and R. C. Davis, 1 p., n.d., decl. 3/11/48.

For publication in the Bulletin of the American Physical Society.

This document is an abstract and is presented here in its entirety.

Anthracene has proved more satisfactory for scintillation counters than naphthalene. Cobalt 60 gamma rays produce 3.5 times larger pulses in anthracene than in naphthalene permitting the use of a lower background counting rate.

A polonium beryllium neutron source gave five times greater counting rate with anthracene than with naphthalene. The maximum pulse size was also five times as great in anthracene. The counts were shown to be due to fast neutrons by an absorption curve in lead and in cadmium. The fast neutron detection efficiency seems to be 10 - 15 per cent.

AECD - 1803 Beryllium Symposium, Held at the University of Rochester School of Medicine and Dentistry, 10 and 11 December 1946, by A. H. Dowdy, 117 p., September 1947. (II-188-7365).

Disposition as required for use in research, development, and manufacturing work.

This report is made up of a series of papers numbered AECD-1803-A through AECD-1803-I. These papers are individually abstracted below:

AECD - 1803-A Introduction, by H. C. Hodge, 2 p., September 1947.

At present, information on the relationship between dosage and response is only partly available in the case of beryllium poisoning.

The purpose of this conference was to review in detail what is known of two aspects of beryllium poisoning: first, to present clinical findings in industrial beryllium poisoning; and, second, to describe the exposures preceding the development of the toxic symptoms. It is hoped that from this conference a better understanding of just what beryllium poisoning is will be gained.

AECD - 1803-B New Clinical Syndrome: Delayed Chemical Pneumonitis Occurring in Workers Exposed to Beryllium Compounds, by H. L. Hardy, 18 p., September 1947.

A puzzling disease has appeared in recent years in a concern manufacturing fluorescent lamps in which beryllium compounds are used. Clinical records are presented of 17 known cases of this disease called delayed chemical pneumonitis. The distinctive feature that separates this group from previous reports in literature is the usual delay in onset following common exposure and progression of the disease in spite of change in environment.

Prominent symptoms appearing at onset were weight loss, dyspnea, and cough. Anorexia and weight loss were frequently the first symptoms. The next most prominent group of symptoms was gastro-intestinal in character. X-ray picture of the lungs appeared to present a characteristic set of changes. There was diffuse stippling amounting to a ground glass appearance, and the hilar nodes were sometimes, but not regularly, enlarged. In the acute instances of delayed chemical pneumonitis, emphysema was seen. The cardiovascular findings were readily explained as secondary to the pulmonary pathology. Enlargement of the liver and spleen await explanation. Cyanosis was present at times in all cases. Clubbing of the fingers occurred in two cases, and tremor of the hands and thyroid enlargement were found in the instance of two onsets.

Of the group of 17 patients, one has definitely recovered. Six of the patients are gradually improving clinically but still show changes in the lungs by X-ray. Three patients are still very much disabled, one is orthopneic even at rest, and six of the group have died.

Every kind of treatment was tried including the sulfonamides and penicillin with no effect. Supportive measures, protection from infection, the wise use of oxygen and attention to the patient's morale proved definitely helpful.

The informal presentation following the formal paper describes 13 additional cases of the disease.

AECD - 1803-C Acute Pulmonary Beryllium Poisoning Six Cases, by R. S. Grier, 6 p., September 1947.

Six cases of pneumonitis in men from the same metallurgical research laboratory have been presented, who were exposed for approximately three months (with one exception of 3 years) either to metallic beryllium of beryllium oxide.

The chief and most striking sympton in all cases was that of exertional dyspnea which ranged from shortness of breath on one flight of stairs to severe dyspnea on any exertion beyond sitting quietly. Four of the six cases complained of pain in the chest lasting from ten to fourteen days and accentuated by activity. Three of the cases complained of a cough which was usually dry and nonproductive. Three of the cases had noted weight loss ranging from five to twenty pounds. Similarly, two had noted anorexia and vague gastro-intestinal symptoms with gaseous indigestion and feeling of bloating.

These cases are of interest because only two forms of beryllium are incriminated, namely beryllium oxide and metallic beryllium in high purity.

AECD - 1803-D A Questionable Case of Beryllium Poisoning, by M. E. Dailey, 2 p., September 1947.

From the evidence presented it appeared that the patient suffered from the effects of a mild but widespread pulmonary fibrosis which was probably due to beryllium dust.

AECD - 1803-E Hazards of the Beryllium Industry, by R. A. N. Turner, 10 p., September 1947.

Approximately ten cases consisting of dermatitis, pneumonitis and sub-acute bronchitis occurred in the laboratory project prior to the Health Hazard Survey. Procedures recommended for the protection of employees are listed. These involve methods of reducing exposure.

There have been between 30 and 50 cases of dermatitis, pneumonitis and sub-acute bronchitis in Plant A. This project employs approximately fifteen persons, and the project includes crushing, grinding, weighing, screening, shaping, machining, and drilling.

The accident record is bad in Plant B. It is recommended that work be done to remedy conditions so that needless suffering and fatalities caused by beryllium and its compounds can be eliminated.

AECD - 1803-F Case Histories and X-rays, Lost-Time Records, Descriptions of Beryllium Poisoning, by J. DeNardi, 61 p., September 1947.

The author has treated 210 cases of acute beryllium poisoning occurring at the Brush Laboratories of Cleveland, Ohio, and the Brush Beryllium Company of Lorain, Ohio. There are two main types of manifestations of the disease: namely dermatologic manifestations and respiratory tract manifestations.

The dermatologic manifestations are contact dermatitis and skin ulcers. These individuals, as well as the group with respiratory reactions, are mainly exposed to fumes and dusts of beryllium fluoride, beryllium oxyfluoride, and beryllium sulfate in the various stations during the processing. The skin lesions occurred frequently as an entity, but in a large number of cases there was an associated upper respiratory manifestation.

The main causes of the dermatitis are believed to be a combination of individual sensitivity plus the irritating effects of the acid radicals. However, the possible effect of beryllium in a compound on the skin cannot be totally eliminated.

The prerequisite for the beryllium ulcer is a small abrasion of the skin into which small crystals of beryllium fluoride or sulfate become imbedded. Contact of the crystal with the tissue fluids by hydrolysis releases the acid radical which in turn destroys the surrounding tissues and produces an ulcer.

The severest form of the disease is pneumonitis. Four deaths have been recorded in the Lorain plant, all fatal cases occurring in 1943. In general, the incidence and severity of this disease was proportional to the degree of exposure and irritation of dusts and fumes in processing the ore.

Brazilian Ore has been used since 1939 when incidences of cases increased, and on testing it proved to contain some uranium.

Case histories of many patients are given.

AECD - 1803-G Descriptions of Certain Processes and Compounds Involved in Beryllium Manufacture by J. Shilen, 7 p., September 1947.

A study of health hazards in a plant manufacturing alloys of beryllium was made.

51.2%, or 271 of total number of employees engaged in production were exposed to fluorides.

6.6%, or 35 were exposed to oxides of nitrogen.

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2%, or 11 were exposed to pickling fumes.

Thirty-seven atmospheric fluoride samples were collected and analyzed for fluorine and, when calculated as sodium fluoride, gave on the average 0.996 mg NaF/m^3. Four samples were taken for dust concentration determination and four and five tenths x 10^6 particles per cubic foot of air, 3.18 x 10^6 particles per cubic foot in the cleaning operation of the crucible furnaces were found. The average dust particle size for six samples were all less than 1.17 microns and many were less than 0.1 micron. Sixteen samples of nitrogen oxide were collected and analyzed and while the results were alarming at first, with improved ventilation, the concentration came down within the limit of 25 P.P. M. Respiratory damage and dermatitis are most frequently reported.

AECD - 1803-H Thirteen Case Histories, by J. Scott, 6 p., September 1947.

Of 13 fatal cases of "delayed chemical pneumonitis" which Dr. Gardner collected, Dr. Scott reported 8 as not associated with phosphors. The case histories of all 8 are given.

AECD - 1803-I Summaries: Suggested Control Measures and Lines of Research; Manifestations of Beryllium Poisoning, by H. C. Hodge, 5 p., September 1947.

Control procedures suggested for protecting the laboratory scientist and the plant employees are:

A. Engineering
   1. Reduce exposure
      a. Inclosed processes
      b. Local exhaust ventilation
      c. Good housekeeping
      d. Proper respiratory protective devices
      e. Protective creams
      f. Personal hygiene -- double lockers, shower, etc.
   2. Survey of processes
   3. Safety supervision
      a. M. D. and engineer cooperation
      b. Comprehensive safety program

B. Supervision
   1. Education of M. D.'s
   2. Complete pre-employment physical examination
   3. Periodic physical examination (including one-month x-ray)

The "best" lines of research are:

A. Toxicological studies of animals
   1. Blood CO_2 combining power -- alkalosis vs dyspnea (Does dyspnea or CO_2 combining power change before X-ray changes?).
   2. Liver - histopathology
   3. Bone -- histopathology
   4. Blood -- phosphatase, globulin (Tiselius)
   5. Lung Function
   6. Selected compounds to compare BeF_2 vs SO_4 vs OF silicate Oxide metal

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7. Distribution, excretion, and storage of beryllium in animals.
8. Phagocytosis
9. Fluorine as a factor

B. Clinical check-up studies on laboratory and plant personnel.
1. Daily (?) vital capacity
2. Weekly x-rays
3. Weekly physicals
4. Standardize x-ray technique
5. Fluoroscopy

Manifestations of Beryllium Poisoning

1. Immediate toxic reaction (with fever and chills) - not a clear-cut entity
2. Dermal lesions
   Dermatitis - primary, direct local contact BeF_2, FeOF, $BeSO_4$, etc.; Ulcer with crystal (BeF_2); Secondary Skin manifestations - granulomatous; Conjunctivitis (SO_4, F, and OF); Corneal lesion (like parathyroid disease - this patient had high blood count and kidney stone)
3. Acute pneumonitis
   Time elapsed between beginning employment and illness:
   40 days, one case; 10 days, BeF_2; 2 - 2½ months, oxide or metal (Grier); 6 months (Dailey)
4. Delayed-prolonged lung disease
   Time elapsed, 5 months to 5 years (average 17 cases, 2 years)

Points of Dissimilarity and Similarity of the Acute and Delayed Manifestations

3 may develop into 4, 3 is less severe, 3 is less disabling, mortality similar(?)

Rarity of Lung Cases:

Hardy: 17 cases of 800 exposed (+13); Grier: 6 cases of 15-40 exposed; Dailey: 1 case of many exposed

Cases heard later:

DeNardi: 210 of unknown number (many of the 210 were skin); Shilen: 23 of 656, in one month (also included skin lesions); Scott: 13 of unknown number

Variability of symptoms:

One of the most confusing aspects of beryllium poisoning is the extrene variability of symptomatology. The most common seem to be as follows: 1) anorexia and loss of weight in mild poisoning, 2) dyspnea and x-ray changes in severe poisoning, 3) precipitating agent plus beryllium as inciting cause rather than beryllium poisoning alone.

The serious absence of defined data on the nature and amount of exposure was frequently commented on.

*AECD - 1804 Cloud Chamber Measurements of Cadmium Capture Gamma Rays, by C. D. Moak and J. W. T. Dabbs, 1 p., n.d., decl. 3/9/48.

For publication in the Bulletin of the American Physical Society.

This document is an abstract and is presented here in its entirety.

A study of the capture gamma rays from cadmium has been made by measuring the energy of the pairs

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produced in a 0.008 cm Pb radiator in a cloud chamber operated in a magnetic field of about 1400 gauss. To reduce the errors arising from scattering, the chamber was filled with helium at a pressure of 3 atmospheres. About 30,000 stereoscopic photographs have been taken which have yielded some 400 acceptable pairs. The pair distribution versus energy plot, and the corresponding gamma ray intensity versus energy curve will be presented. Measurements so far made on about 100 pairs show a peaking of the gamma ray intensity at about 5 Mev and a rather strong group below 2 Mev.

AECD - 1805 The Metabolism of Curium in the Rat by K. G. Scott, D. Axelrod, and J. G. Hamilton, 13 p., January 15, 1948. (UCRL-35).

For publication in the Journal of Experimental Biology and Medicine.

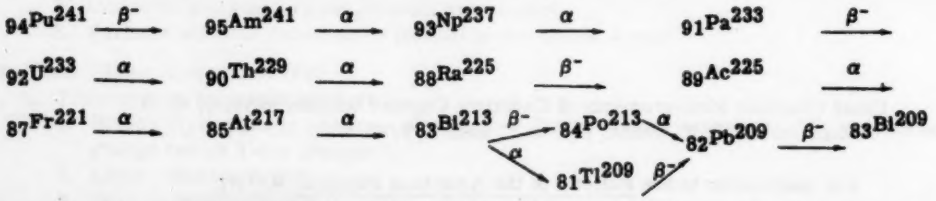
The fate of curium has been studied in the rat 1, 4, 16, 64, and 256 days after intramuscular administration.

About 5/6 of the curium is absorbed in the first 16 days after injection from the site of administration. Upon entrance into the animal, curium is primarily deposited in the liver and skeleton. The curium present in the soft tissues of the body is eliminated, primarily via the gastro-intestinal tract. Curium is not absorbed from the gastro-intestinal tract. Radioautographic studies showed that curium is deposited in the periosteum, endosteum, and trabeculae of the skeleton. Curium is retained by the skeleton for a long period of time. The metabolism of curium and americium in the rat are very similar.

AECD - 1806 The Neptunium (4n+1) Radioactive Family, by G. T. Seaborg, 20 p., January 19, 1948. (ANL-HDY-412).

For publication in a technical journal and for oral presentation as the Nichols Metal Award Address in New York City, March 5, 1948.

The experimental work of the last six or seven years has led to the production and the measurement of the radioactive properties of all the members of the missing, 4n+1 mass type, radioactive family. The main line of decay for this series, for which the name "neptunium family" is suggested by analogy with the names for the other natural radioactive families, is as follows:


$_{94}Pu^{241}$ β^- $_{95}Am^{241}$ α $_{93}Np^{237}$ α $_{91}Pa^{233}$ β^-
$_{92}U^{233}$ α $_{90}Th^{229}$ α $_{88}Ra^{225}$ β^- $_{89}Ac^{225}$ α
$_{87}Fr^{221}$ α $_{85}At^{217}$ α $_{83}Bi^{213}$ β^- $_{84}Po^{213}$ α $_{82}Pb^{209}$ β^- $_{83}Bi^{209}$
α $_{81}Tl^{209}$ β^-

The radioactive properties of Th^{233}, U^{237}, Cm^{241}, Pu^{237}, and Pa^{229}, nuclei of the 4n + 1 mass type but known as "collateral" members because they are not in the direct line of decay of this family, are now also known.

*AECD - 1807 On the Radioactive Decay of the Neutron by A. H. Snell and L. C. Miller, 2 p., n.d., decl. 3/11/48.

For publication in the Bulletin of the American Physical Society.

This document is an abstract and is presented here in its entirety.

A collimated beam of neutrons, three inches in diameter, emerges from the nuclear reactor and passes axially through a thin-walled, aluminum, evacuated-cylindrical tank. A transverse magnetic field behind the thin entrance window cleans the beam of secondary electrons. Inside the vacuum, axially arranged, an open-sided cylindrical electrode is held at +4000 volts with respect to ground. Opposite the open side a smoothed graphite plate is held at - 4400 volts. The field between these electrodes accelerates and focuses protons which may result from decay of neutrons, so that they pass through a 2-7/8 x 1-5/8 inch aperture in the center of the graphite plate, and strike the first dynode of a secondary electron multiplier. The first dynode is specially enlarged so as to cover the aperture. Readings are taken (1) with and without a thin B^{10} shutter in the beam; (2) with and without a thin foil over the multiplier aperture; (3) with and without the accelerating voltage. In a total counting rate of about 300 per minute, about 100 are sensitive to operations (1), (2), and (3). In the absence of the accelerating field or with the foil (2) in operation (1) does not change the counting rate. Assuming all of the 100 cpm to be due to decay protons, preliminary estimates of the collecting and counting efficiency (10%) and of the number of neutrons in the sample (4×10^4) give for the neutron a half-life of about 30 minutes. It is at present much safer however to say that the neutron half-life must exceed 15 minutes. Coincidences are presently being sought between the disintegration betas and the collected protons.

AECD - 1808 A Preliminary Report of the Effect of X-Rays on the Mitotic Activity of Skin, by N. P. Knowlton, Jr., et al., 4 p., n.d., decl. 3/9/48. (LADC-492).

For publication in Science.

Mitotic index of the skin of the mouse has been studied as a means of measuring the biological effect of X-rays at doses of 35 and 325 r. As little as 35 r of 250 kv X-rays produce a drop in the mitotic index to zero within one to two hours after radiation. The number of mitoses returned to normal within a few hours after radiation. The time required for the number of mitoses to return to normal increases greatly with increased radiation dosage. It is believed that the time required for the mitotic index to return to normal will provide an excellent basis for rating the biological effectiveness of radiation of different types and different energies. With 325 r of X-rays the mitotic index required six days to return to normal and continued to increase to more than twice normal. This is believed to be an over compensation phenomena which may also be used as an index of radiation damage.

AECD - 1809 The Alpha-Ray Emitting Isotope in Samarium, by A. J. Dempster, 4 p., February 9, 1948. (ANL-AJD-230).

For publication in Physical Review.

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The previously reported mass assignment of the alpha-ray emitting isotope in samarium is shown to be unreliable. Preliminary experiments indicate that it is at mass 152 rather than mass 148.

Further experiments are in progress using the list anode ion source in which the isotopes are collected in small hollow chambers to avoid loss by sputtering and more complete results may be obtained in the near future.

AECD - 1810 Ion-Exchange Separation of the Alkali Metals, by W. E. Cohn and H. W. Kohn, 4 p., n.d., decl. 3/16/48.

For publication in the Journal of Biological Chemistry.

This report is an abstract and the entire text is given here.

Preliminary results on the separation of alkali-metal ions by an ion-exchange procedure are reported. Interest in this separation stems partly from the general interest in the laboratory in ion-exchange as an analytical and preparative technique and partly from the need for a more precise and easily-effected separation of Na and K for use in biological tracer experiments. Although the separation of Na and K was the prime purpose of the investigation, four of the alkali metals (Na, K, Rb, Cs) were investigated simultaneously.

Equilibrium experiments, in which samples of radioactive Na and K were shaken for 24 hours with Dowex-50 under varying conditions of acidity and ionic strength, served to set the conditions for the column separation run reported below. The column separation itself made use of the identical column and resin bed used by Mayer and Tompkins in their 61-Eu separation (1.0 cm^2 x 10.4 cm colloidal agglomerates of Dowex-50; 2.83 g oven-dried resin weight; 8.84 ml bed solution volume) and a recording counter to assay the relative activity in the effluent solution.

A mixture of 1.0 mg Na, 10 mg K, 8 mg Rb and 13 mg Cs, in the form of their carbonates, was exposed in the uranium-graphite pile for several days, then removed, converted to the chlorides, dissolved in water and absorbed on the column, which was in the hydrogen form. Elution was then begun with 0.15 N HCl at a flow rate (ca 0.3 ml/min) slow enough to permit an approach to equilibrium conditions. The effluent from the column was collected in a number of fractions, each of which was radiometrically analyzed for its Na^{24}, K^{42}, Rb^{86}, and Cs^{134} content.

The results are shown in a graph which is a plot of concentration of element vs volume of effluent in the various fractions collected. The automatically-recorded curve (normalized) is superimposed upon the block diagram and serves to locate the valley between Na and K and the peak of K, both of which occurred while the column was unattended. The table at the top of the figure shows the relative purities and recoveries which were obtained in various fractions.

Although the Na-K separation is practically quantitative (a preliminary trial with 0.2 N HCl also gave essentially complete separation of Na and K), K-Rb and Rb-Cs are not so, nor is the method yet of the desired speed with respect to the half-lives of Na^{24} and K^{42}.

Improvement in the K-Rb and Rb-Cs separations will be sought by utilizing other acids and/or complexing agents. However, immediate application of the procedure to the problem of preparing very pure alkali metal salts or radioisotopes is possible. It is also of interest to note that the heights and positions of the peaks are consistent with the Mayer-Tompkins formulation, indicating the same number of plates in the column with respect to each of the elements studied.

AECD - 1811 Stack Gas Dilution in Cross Winds, by A. F. Rupp, et al., 28 p., May 20, 1944. (CE-1620 [A-2476]).

Disposition as required for use in research, development, or manufacturing work.

Experiments with small stacks discharging into gentle cross winds showed that the cone of stack gas is bent toward the path of the wind and eventually travels along with the wind, further rise of the gas due to its original stack velocity being negligible compared with vertical eddy diffusion of the cloud. The height and distance downstream from the stack where the cloud becomes substantially horizontal is shown to be

$$H = 1.5 \frac{V_s}{V_w} d_s$$

$$J = 1.5 \frac{V_s}{V_w} d_s$$

where H = height, J = distance down stream, d_s = stack diameter, V_s = stack velocity, V_w = wind velocity, and the diameter of the cloud at this point is,

$$d_{CH} = \frac{V_s}{V_w} d_s .$$

These empirical relations are satisfactory for practical calculations.

Use is also made of the Towle and Sherwood eddy diffusion equation for estimating the concentration of a contaminant at points in the horizontal cloud well beyond the curved portion near the stack.

AECD - 1812 Decay Scheme of Y^{88} (104d), by W. C. Peacock and J. W. Jones, 15 p., n.d., decl. 3/10/48..

For publication in Physical Review.

Yttrium was separated without added carrier from a strontium cyclotron target by dissolving the strontium in 0.1 N HCl, neutralizing to pH of 4, extracting with an equal volume of a 5% solution of a derivative of acetylacetone in benzene, then extracting back into an equal volume of HCl at a pH of 2.

After concentration, the solution containing the yttrium activity, was dried onto a 50 $\mu gm/cm^2$ film consisting of laminated Formvar and polystyrene. This film was supported in a paraffin lined chamber at the source end of a thin lens-type beta ray spectrometer.

The spectrometer contained a baffle for separating positive and negative electrons, so that with one direction of the coil current the positive electrons were observed, and with the other direction, negative electrons.

The negative electron spectra was plotted with ordinant proportional to electrons per unit momentum N/I (counting rate divided by current) and abscissa proportional to momentum, I (current in amperes). Three peaks were noted. The peak with a maximum at 3.94 amperes decays with a half-life of 71±5 hours and was assumed due to internal conversion electrons from Y^{87} produced with Y^{88} at the time of bombardment. The electron energy is 0.374 ±0.006 Mev and the corresponding gamma ray would have an energy of 0.390 ±0.006 Mev. Peaks with maxima at 7.15 and 12.55 amperes are internal

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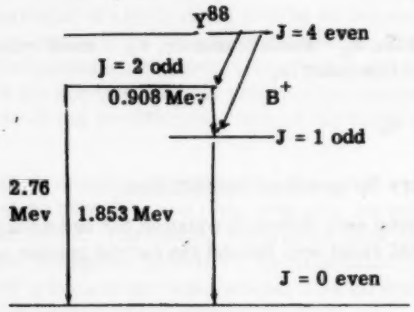
conversion electrons from Y^{88}. These measurements indicate gamma rays at 0.908 and 1.853 Mev in agreement within the probable error of about 2%, with values previously reported by others.

The positive electron spectrum of the same source is shown in a graph. If it is assumed that all of the positrons originate from beta decay, and a Kurie plot is made, the end point comes at 0.83 ± 0.02. Mev. If the positron plot be modified to give a straight Kurie plot, the area under the resulting curve multiplied by the "transmission constant" and compared with the absolute disintegration rate of the source, indicates that positrons are emitted in at most $(1.9 \pm 0.4) \times 10^{-3}$ of the cases. Internal conversion coefficients for the two gamma rays (including conversion in all shells) are found in the same way to be: 2.7×10^{-4} and 1.3×10^{-4} for the 0.908 and the 1.853 Mev gamma ray, respectively. A thick aluminum radiator was mounted over the yttrium source in order to observe the Compton electrons from the crossover gamma ray. Compton electrons from this gamma ray have an inspection end point at 2.52 ± 0.05 Mev indicating that the gamma ray energy is very close to $0.908 + 1.853 =$ 2.761 Mev (value calculated from this energy Compton end point is 2.75 ± 0.05).

A proposed decay scheme for Y^{88} is given as follows:



*AECD - 1813 Artificial Alpha-Active Bismuth Isotopes, by D. H. Templeton and I. Perlman, 4 p., February 6, 1948. (UCRL-50).

For publication as a Letter to the Editor of Physical Review.

This paper is an abbreviated version of a section of MDDC-1525.

Four new alpha-emitters of half lives 2 min, 9 min, 27 min, and 1-2 hr have been found from the bombardment of lead with high energy deuterons. The three of longest half-life have been identified as isotopes of bismuth. It is believed that the mass numbers of all of the isotopes are less than 203.

AECD - 1814 Vacuum Testing at SAM Laboratories, by J. E. Binns, F. S. Stein, C. R. A. Rice, and S. Bashkin, 57 p., n.d., decl. 3/22/48.

Disposition as required for use in research, development, or manufacturing work.

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A discussion of the general theory of leak testing is given, followed by the development of the pumping unit and leak testing technique. In a sense all leak testing is pressure testing, since the only efficient way to make a fluid pass through a wall is to apply different pressures to the two sides. If, however, one of these two pressures is less than atmospheric pressure, the method is commonly known as vacuum testing method; as a pressure testing method. The gas analyzer which is operable at the lowest pressures is the mass spectrometer; this is, therefore, the best instrument for dynamic leak testing.

A schematic diagram of a complete leak testing system using a mass spectrometer is given. There are two complete diffusion pumping systems. The one associated with the spectrometer tube is for the purpose of maintaining a pressure of about 10^{-4} mm in the tube regardless of the pressure in the test vessel. In the main pumping system is found a diffusion pump of the "booster" type with high speed at moderately high pressures and a cutoff pressure of about 10^{-4} mm.

Various traps are used for the purpose of protecting certain parts from vapors and to aid the pumps in producing a high vacuum.

Leaks may be localized either by the isolation method or by the probe method. In the isolation method the surface to be tested is divided up into several mutually isolated regions and the helium is applied to each of these regions in turn. Although this method does not yield detailed information, it is often sufficient and is sometimes useful as a preliminary to probing. The probe method consists in exploring the exterior of the object with a jet of helium. In general, this is a tedious but fruitful method; at its best, leaks can be localized to within 1/8". The higher the dynamic sensitivity the more successful the probe method becomes.

*AECD - 1815 Elimination of Interference by Nickel in the Determination of Uranium by Means of Zinc Amalgam Reductors, by F. S. Grimaldi, 5 p., n.d., decl. 3/9/48.

To be included in the NNES(MPTS).

The observation that zinc amalgam reductors are poisoned by solutions containing nickel is confirmed; experiments are described showing the effect in hydrochloric acid solutions. The effect is caused by deposition of metallic nickel on the amalgam surface, promoting vigorous evolution of hydrogen. This interference is easily overcome by using a solid amalgam richer in mercury (10% by weight), thus lowering the activity of the zinc enough to prevent deposition of metallic nickel.

Either hydrochloric acid or sulfuric acid solutions may be used. The valence changes during reduction of the elements commonly determined by means of the Jones reductor are the same for the "10%" reductor and the standard reductor.

AECD - 1816 A Rapid, Precise Microbalance Technique, by D. E. Hull, 17 p., n.d., decl. 3/18/48.

For publication in Analytical Chemistry.

In an effort to speed up the process of routine weighing on a commercial microbalance at a precision of the order of one microgram, a study has been made of the conditions under which the operator might remain continuously at his seat in front of the balance without the thermal disturbances to the balance which would normally ensue.

It is shown that by maintaining the balance room at a temperature approximating the skin temperature of the operator, the disturbances due to the operator's presence are reduced to negligible proportions, and rapid weighing to a reproducibility of 0.7 micrograms probable error has been accomplished. A procedure which permits continuous weighing under less ideal conditions to a probable error of only slightly more than one microgram is also described.

The use of these techniques is illustrated in a brief study of the weight of platinum disks during ignition and cleaning with acid, and in use as electrolytic cathodes. It has been found possible to maintain constant weight within the error of weighing during cleaning and ignition, but not during use as an electrode.

AECD - 1817 Wide Range Frequency Modulation, by K. R. MacKenzie, 5 p., October 16, 1947. (BP-144).

For publication in Physical Review.

The cyclotron frequency modulation systems, so far proposed, utilized mechanical variation of capacity. This capacity is most effective when placed at the leading edge of the dee. In this position, however, many difficulties are introduced. A system has been developed at the Radiation Laboratory, in which the variable capacitor is outside the magnetic field. Tests made with a one-half scale model of the proposed system for the 184-inch cyclotron show that a frequency range of 2.4 to 1 can be covered continuously. This range can be shifted approximately 10 per cent by addition of fixed inductance or capacity. Since the frequency ranges required for protons and deuterons in the 184-inch magnetic field are 22.9 to 15.8 megacycles, and 11.5 to 9.8 megacycles, respectively, it seems that the cyclotron can accelerate either type of ion by making minor adjustments, or possibly both ions at once if so desired. Recent measurements on the 184-inch cyclotron indicate that the required frequency range need be only a few per cent greater than the theoretical range, and also the shape of the frequency time curve is not critical.

A schematic diagram is shown and discussed.

AECD - 1818 On Closed Shells in Nuclei, by M. G. Mayer, 8 p., February 1948. (ANL-HDY-428).

For publication in Physical Review.

In this paper, the experimental facts indicating a particular stability of shells of 50 and 82 protons and of 50, 82, and 126 neutrons are listed.

For elements with even Z, the relative abundance of a single isotope is not greater than 60%. This becomes more pronounced with increasing Z; for $Z > 40$, relative abundances greater than 35% are not encountered. The exceptions to this rule are given. The isotopic abundances are not symmetrically distributed around the center, but the light, neutron-poor isotopes have low abundances. The concentration of the lightest isotope is, as a rule, less than 2%. The exceptions to this rule are listed.

The average number of isotopes for odd neutrons number is somewhat less than 1; the same number for even N varies as a rule between three and four. The greatest number of isotones, attained only once in the periodic table, is 7 for neutron number 82; 6 isotones are encountered once only, and for neutron number 50.

In the case of neutron number $N = 82$ two isotones of odd Z are found, La and Pr. The same is the case for $N = 50$, where the unstable, but long- lived, Rb^{87} and Y^{89} differ only in proton number. The limit of stability for neutron-rich isotopes stays at constant neutron number for $N = 50$ and $N = 82$, namely the pairs of isotones Kr^{86}, Sr^{88} and Xe^{136}, Ba^{138} are the heaviest isotopes of their elements.

Sn, $Z = 50$, has without exception the greatest number of isotopes of any element, namely 10. Its heaviest and lightest nuclei differ by 12 neutrons. Such a spread of isotopes is encountered in only one other case, namely at Xe, where it may be attributed to the stability of Xe^{136} with 82 neutrons.

Lead, $Z = 82$, is the end of all radioactive chains. It has only 4 stable isotopes, of which the heaviest one, Pb^{208}, has 126 neutrons.

Evidence for the stability of 82 protons and 126 neutrons can be obtained from the energies of radioactive decay.

Absolute abundances are notoriously uncertain. For the light elements, the abundances vary erratically; for heavy elements, from about Se on, they remain roughly constant. In the region of heavy elements, the following abundance peaks are apparent. At Zr (50 neutrons), at Sn (50 protons); at Ba (82 neutrons), at W and at lead (82 protons or 126 neutrons).

The abundances of rare earths heavier than samarium are reasonably constant, except that the elements with even Z are about 5.7 times as abundant as those with odd Z. Of the lighter rare earths, however praesodymium, ($N = 82$), is about 8 times, and lanthanum ($N = 82$), about 27 times as abundant as the average of the odd rare earth with greater Z.

If 50 or 82 neutrons form a closed shell, and the 51st and 83rd neutron have less than average binding energy, one would expect especially low binding energies for the last neutron in Kr^{87} and Xe^{137}, which have 51 and 83 neutrons, respectively, and the smallest charge compatible with a stable nucleus with 50 or 82 neutrons, respectively. It so happens that the only two delayed neutron emitters identified are these two nuclei.

The neutron absorption cross-sections for nuclei containing 50, 82, or 126 neutrons all seem to be unusually low.

AECD - 1819 The Determination of Palladium and Nickel with Alpha-Furildioxime, by S. A. Reed and C. V. Banks, 13 p., n.d., decl. 3/9/48.

For publication in the Proceedings of the Iowa Academy of Science.

Alpha-furildioxime was found to be more sensitive as a qualitative reagent for nickel and palladium than dimethylglyoxime. Under the optimum conditions 1 part of nickel was easily detected in 6,000,000 parts of an aqueous solution while 1 part of palladium in 20,000,000 parts of an aqueous solution was readily detected.

Alpha-furildioxime was found to be a satisfactory reagent for the quantitative precipitation of palladium; serving to separate palladium from nickel, platinum, cobalt, iron, and many other metals with a single precipitation from strong mineral acid solutions. The palladium alpha-furildioxime precipitate may be dried and weighed or it may be ignited to the metal.

Alpha-furildioxime was found to quantitatively precipitate nickel but its use as a reagent for this metal is precluded by the fact that the composition of the nickel alpha-furildioxime complex varies with the pH of the solution from which it is precipitated.

AECD - 1820 Reaction Constants for $Li^7(p,n)Be^7$, by R. Taschek and A. Hemmendinger, 38 p., n.d., decl. 3/17/48. (LADC-469).

For publication in Physical Review.

Absolute values for the reaction cross section of $Li^7(p,n)Be^7$ are given for proton energies between 1.86 Mev and 2.5 Mev. Detailed angular distributions and their analyses are presented and the use of the reaction as a variable energy neutron source is discussed. Results are plotted.

In all the work reported the Los Alamos Van de Graaff generator was used. This machine provides up to 60μ.a. of magnetically analyzed protons or deuterons at a maximum usable energy of 2.7 Mev with an energy control of about $\pm$ 1.5 kev and a focus of approximately 2 mm diameter, at a distance of 1.5 meters from the analyzing magnet.

The absolute value of the reaction cross section was determined by a comparison of the total neutron flux from the $Li^7(p,n)Be^7$ source with the total neutron flux from a standardized RaBe source. The source strength for the RaBe source standard is known to approximately $\pm$ 5 per cent.

*AECD - 1821 Properties of the 4-Second Neutron Emitter of Low Z, by L. W. Alvarez, 1 p., February 25, 1948. (UCRL-54).

For oral presentation before a meeting of the American Physical Society to be held in Washington, D. C., April 29 to May 1, 1948, and for publication in the Bulletin of the American Physical Society.

This document is an abstract and the entire text is presented here.

A gas flow method has been used to show that a nitrogen isotope is responsible for the delay. The number of neutrons in the active nucleus is known from the work of Lawrence and Moyer, so the complete identification is N^{17}. In support of the Bohr-Wheeler hypothesis, "neutron-β" coincidences have been observed. The neutrons themselves are not detected, but instead, the recoiling 0^{16} nuclei are observed in an atmospheric pressure proportional counter, through which passes a stream of He carrying N^{17}. The pulse size distribution of the recoils gives directly the differential neutron distribution and this is observed to be very broad. Preliminary results show a maximum at zero energy, with a tail extending to more than 2 Mev. Its shape is probably due to the fifth power law of β-decay, in which case it is not the true neutron width. Preliminary absorption measurements of the β-rays in coincidence with the neutrons indicate an upper limit of $2.7 \pm .4$ Mev. With the improved apparatus now in use, it should be possible to determine the neutron spectrum accurately and look for the expected variation of β-ray upper limit with neutron energy.

*AECD - 1822 Magnetic Properties of Some Actinides, by M. Calvin, 1 p., December 1947. (ANL-JJK-14B-85).

For oral presentation at the American Chemical Society Symposium to be held in April 1948.

This document is an abstract and the entire text is presented here.

The magnetic susceptibilities of some transuranium elements in aqueous solution have been measured by a modified Gouy method involving the application and measurement of the magnetic forces in a direction normal to the gravitational weight of the sample. The significance of these magnetic susceptibilities with respect to the electronic configuration of the ions will be discussed and a comparison will be made with magnetic susceptibilities of rare earth ions.

*AECD - 1823 Production of N^{17} by Deuteron Bombardment, by W. W. Chupp and E. M. McMillan, 1 p., February 25, 1948. (UCRL-53).

For oral presentation before a meeting of the American Physical Society to be held in Washington, D. C., April 29 to May 1, 1948, and for publication in the Bulletin of the American Physical Society.

This document is an abstract and the entire text is presented here.

The nucleus N^{17} offers a unique opportunity for studying many particle reactions among the light elements, since its specific property of giving 4.13 second delayed neutrons allows it to be easily distinguished.

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The yield of delayed neutrons from a number of substances bombarded by an external beam of 195 Mev deuterons from the 184-inch cyclotron has been examined. The beam passed through a monitor consisting of a thin LiF crystal and then through a thin sample of known surface density; after 30 seconds exposure the sample was allowed to fall into a sensitive re-entrant BF_3 chamber and the monitor was pulled alongside a BF_3 counter, and then simultaneous counts were taken for 30 seconds. The chambers were heavily shielded by paraffin to reduce background. Two kinds of measurements were taken: (1) comparisons of the relative yields per atom, and (2) excitation curves as the deuterons were slowed down by copper absorbers between monitor and sample.

The relative yields per atom show a roughly exponential decrease with the number of particles emitted, as indicated:

O not incl. O^{16}	F	Na	Mg	Al	Si	P	S	C	K
100,000	8400	2600	840	840	230	230	70	78	25

The excitation curves are monotonic with energy and show thresholds increasing with Z.

AECD - 1824 Survey of Studies on the Valence States of Some Secondary Fission Products, by C. D. Coryell, 19 p., n.d., decl. 3/26/48.

For oral presentation at the Symposium on Isotopic Exchange and Molecular Structure sponsored by the Centre National de la Recherche Scientifique Paris.

Chemical procedures are presented for the identification of the valence distribution of a number of elements when these are present in tracer concentrations. These elements include selenium, bromine, tellurium, iodine, and cerium.

These procedures have been used to explore the valence states of Se^{83}, $Te^{(132)}$ and three isotopes of I in typical fission product mixtures. Selenium was found to be 95% selenite and 5% selenate; tellurium about 65% as tellurite and 35% as tellurite, and iodine in slightly alkaline solution about 45% in reduced states, 45% as iodate, and 10% as periodate (with a higher fraction of reduced states for $I^{(132)}$.

Studies of the valence state of 33h Ce^{143} growing from 19m La^{143} in the presence of an adsorbent for ceric tracer showed that over 60% of the newly formed Ce^{143} is in the tetravalent state.

Studies of the valence state of Br growing from $Se^{83}O_3^=$, $Se^{83}O_4^=$, and $Se^{84}O_4^=$ indicate that approximately 60% is in reduced states and 40% in the bromate state irrespective of reaction conditions used.

Studies on the valence state of 2.4h $I^{(132)}$ growing from 77h $Te^{(132)}$ show ratios of reduced forms to IO_3^- to IO_4^- of 75:14:11 for tellurite decay and 60:28:12 for tellurate decay.

Studies on the valence state of 72m Te^{129} formed from isomeric transition of the 32d Te^{129*} show that parent tellurate gives 55% daughter tellurite in acid solution and 40% in alkaline solution and that parent tellurite gives no daughter tellurate in acid solution and 14% in alkaline solution.

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Different effects are noted with isomeric pairs of mass numbers 127 and 131. The decay of 32d Te^{129*} in gaseous TeF_6 leads to retention of the 50% of the 72m daughter in forms volatile at -78°C.

Little work has been done previously to determine the valence state of products of nuclear transformation, and there is little basis for prediction of the results. These studies are presented largely from the experimental side. They do not lend themselves readily to broad interpretation.

AECD - 1825 Angular Distribution of n-p Scattering with 90 Mev Neutrons, by J. Hadley, et al., 6 p., n.d., decl. 3/9/48. (UCRL-51).

For publication as a Letter to the Editor of Physical Review.

One of the important experiments that became feasible as soon as the 184" cyclotron started to operate was the measurement of the angular dependence of n-p scattering.

The neutron-beam of the cyclotron has an angular distribution well described by Serber's stripping theory. It is assumed that the energy distribution of the neutrons is also that predicted by this theory; i.e., has a maximum at 90 Mev; the corresponding wave length in the center of mass system is $\lambda = 0.95 \times 10^{-13}$ cm.

These neutrons were used to measure the n-p cross section as a function of the angle of scattering θ, in the CM system, between 70° and 170°. A schematic layout of the apparatus is given. The neutron beam produced by stripping 180 Mev deuterons on a Be target was collimated to about 2.5 cm diameter and scattered by paraffin or polyethylene targets which were larger in diameter than the neutron beam. The recoil protons used for the measurement were detected by a telescope of 3 proportional counters in coincidence pointing towards the scatterer. The primary neutron beam was monitored either by the protons scattered by an auxiliary hydrogenous target or by a bismuth fission chamber.

The peak of protons obtained in the forward direction indicates the existence of exchange forces between neutron and proton. A more detailed analysis that takes into account the total scattering cross section and the angular distribution indicates that there might be comparable amounts of ordinary forces.

*AECD - 1826 Delayed Emission of Neutrons from the Decay of N^{17}, by N. Knable, et al., 1 p., February 25, 1948. (UCRL-52).

For publication in the Bulletin of the American Physical Society, and for oral presentation before a meeting of the American Physical Society to be held in Washington, D. C., April 29 to May 1, 1948.

This document is an abstract and the entire text is presented here.

The bombardment of oxygen and elements immediately above it in atomic number with 195 Mev deuterons is observed to yield a delayed emission of neutrons decaying with a half-life of slightly over four seconds.

Measurements of the decay periods, with a BF_3 proportional counter corrected for resolving time, for target elements from oxygen through chlorine gave a single half-life of $4.14 \pm .04$ seconds.

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Observation of the intensity of gamma radiation, together with the magnitude of the yield of delayed neutrons, precluded an explanation in terms of γ-n reactions.

Bombardments of various elements by deuterons, protons, and neutrons indicated that the active isotope responsible for the decay period leading to the neutron emitter must have $Z \leq 8$ and $A - Z = 10$. Subsequent experiments by Alvarez (see AECD - 1821) definitely assigned the effect to a nitrogen isotope, identifying N^{17} as the nucleus which carries the phenomenon.

Results of a general search through the periodic table for such effects will be reported. Complex decay curves for delayed neutrons from Ce, Gd, Pt, Au, Hg, Tl, Pb, and Bi will be shown.

AECD - 1827 Electronic Classifying, Cataloging, and Counting Systems, by J. H. Parsons, 22 p., n.d., decl. 3/25/48.

For publication in the Proceedings of the Institute of Radio Engineers, and for oral presentation at the National Convention of the Institute of Radio Engineers.

An abstract of this document has previously been issued as MDDC - 1625 and listed in this journal.

*AECD - 1828 On the Tripartition of U^{235} Nuclei by Thermal Neutrons, by L. Rosen and A. Phillips, 1 p., n.d., decl. 3/29/48. (LADC-496).

For oral presentation before a meeting of the American Physical Society to be held in Washington, D. C.

This document is an abstract and the entire text is presented here.

By making use of a triple ionization chamber, a triple coincidence circuit and a gated 10 channel amplitude discriminator it has been found possible to set an extremely low limit on the frequency of triple fissions in the case that none of the fragments have either very low energies or very low masses.

Pulses from all three ionization chambers were amplified and fed to the triple coincidence circuit within its resolving time (1 μs) the 10 channel amplitude discriminator was triggered and the pulse from counter II recorded. If this pulse was greater than 105 Mev, it was assumed to be due to two fragments from two different fission events and thus was discarded. This made it possible to eliminate about 80% of the accidental coincidences.

The results of this experiment are as follows: Frequency of tripartition when each fragment has an energy greater than 25 Mev and a mass greater than 20 mass units (charge greater than 10 electronic charges) is less than one per 2×10^5 binary fissions. Frequency of tripartition in the case of symmetric fission is less than one per 10^6 binary fissions.

AECD - 1829 **The Chemical Properties of Elements 94 and 93, by G. T. Seaborg and A. C. Wahl, 22 p., March 19, 1942.**

Published in the Journal of the American Chemical Society Vol 70, p 1128-1134, March 1948.

In the reduced states the precipitation reactions of neptunium and plutonium are similar to those of the tripositive rare earths and actinium, and of the quadripositive cerium, thorium and uranium. Neptunium and plutonium resemble actinium, thorium and +4 uranium in that their fluorides, iodates and hydroxides are insoluble in water; their sulfides are soluble in acid; and their metals are electropositive. Neptunium and plutonium exhibit a higher oxidation state with properties similar to those of uranium of oxidation state +6.

Probably the reduced state of both elements has an oxidation number of +3 or +4 and the fluoride formulae are NpF_3 and PuF_3 or NpF_4 and PuF_4. For both elements the standard oxidation-reduction potential from the metal to the reduced ionic state is greater than +0.5v. For the reduced to the oxidized ionic state the standard potential for neptunium is about -1.35v and for plutonium, -1.0 to -1.4v. Probably PuO_2 and NpO_2 are the oxides formed by electrodeposition.

There is practically no resemblance in chemical properties between neptunium and plutonium and rhenium and osmium. The chemical properties of neptunium and plutonium indicate that a "rare earth" type group of elements is starting at the upper end of the periodic table, though from the present data the group can just as well be considered to be starting with actinium or thorium, rather than with uranium which has been previously suggested as the starting point.

AECD - 1830 **Nuclear Properties of 93^{237}, by A. C. Wahl and G. T. Seaborg, 4 p., April 13, 1942.**

For publication in Physical Review.

The bombardment of uranium with fast neutrons produces the beta-emitting 6.8-day U^{237}, formed in the reaction, $U^{238}(n,2n)U^{237}$. 93^{237}, the daughter of U^{237}, was investigated, the primary purpose of the investigation being to measure the fission properties of this isotope. Measurements, performed upon a sample weighing about 0.6 microgram, show that 93^{237} does not undergo fission with slow neutrons. Experiments show that 93^{237} is an alpha-emitting isotope with a half-life of about 3×10^6 years.

AECD - 1831 **Loss of Radioactivity from Barium Carbonate Samples, by P. E. Yankwich, 8 p., January 9, 1948. (UCRL- 33).**

For publication in Science.

The exchange loss of radioactivity from solid samples of barium carbonate through the agency of carbonic acid and its ions has been investigated under a variety of conditions. It is concluded that the losses observed are greatly dependent upon the method of sample preparation, in particular the nature of any heat treatment which the sample materials undergo.

It is certain that barium carbonate-carbon dioxide exchange can occur rapidly only when the solid is in contact with a medium in which both carbon dioxide and barium carbonate are appreciably soluble; this is demonstrated by the failure to observe exchange when alcoholic solutions are used. There is

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also a surface effect involved, for under the same conditions precipitates which had not been warmed exchanged much more rapidly than those which had been subjected to heating; such effects are well known and are responsible for the solubility denaturation of such precipitates as aluminum and ferric hydroxides.

AECD - 1832 Degradation of Isotopic Lactate and Acetate, by S. Aronoff, V. A. Haas, and B. A. Fries, 10 p., February 24, 1948. (UCRL-55).

For publication in Analytical Chemistry.

A scheme of glucose degradation has been validated by the use of intermediates of known isotopic composition. In this scheme: glucose →lactic acid →CO_2 (C-3,4) + acetic acid→CO_2 (C-2, 5) + acetone →iodoform (C-1,6) + acetate (C-1,6; 2,5), it was found that (a) in the oxidation of lactic acid, approximately 4.7% of the acetic acid was oxidized to CO_2; and (b) under the conditions prescribed, $BaCO_3$ from the degradation of Ba acetate contained approximately 1.5% of the activity of the methyl group.

AECD - 1833 Yield of Photoneutrons from U^{235} Fission Products in Be, by S. Bernstein, F. L. Talbott, J. K. Leslie, and C. P. Stanford, 23 p., February 20, 1948. (CNL-38).

For publication in a professional journal.

The yield of photoneutrons from a sample of 25 fission products at the center of a nine inch diameter Be sphere has been studied. Samples of U^{235} were exposed in the pile for periods of 30 seconds, 15 minutes, six hours, and 74 hours. The photoneutrons were observed from 0.3 seconds to about four weeks after the end of the exposure. Curves showing the photoneutron yield relative to the delayed neutron yield as a function of time are given for these exposure and observation times. A comparison is made between the photoneutron yield of infinite thicknesses of D_2O and Be for a six hour exposure. This comparison shows that the yield from Be is less than that for D_2O for times less than about one-half hour after the end of the exposure and that the yield from Be becomes increasingly greater than that for D_2O for times greater than one-half hour. A possible explanation of the relative yields of Be and D_2O with time in terms of the variations of the photodisintegration cross sections with energy and the average variation of fission product gamma ray energy with time is proposed.

On the average the hardest gamma rays are emitted at the shortest times. Since the cross-section for Be at high energies is less than that of the deuteron the number of photoneutrons is less for Be at short times after the end of the exposure. At greater times, the gamma ray energy becomes smaller, the cross-section of Be becomes greater, and, therefore, the number of photoneutrons from Be becomes greater.

AECD - 1834 The Thermodynamics of Gaseous, Cuprous Chloride Monomer and Trimer, by L. Brewer and N. L. Lofgren, 41 p., January 2, 1948. (UCRL-25).

Disposition as required for use in research, development, or manufacturing work, and also for publication in a technical journal.

The existence of a trimeric molecule, Cu_3Cl_3, in cuprous chloride vapors was disclosed as a result of measurements of volatility of cuprous chloride in hydrogen-hydrogen chloride mixtures over copper metal. This conclusion was verified by vapor density measurements at 1119°K with pure cuprous chloride. At the boiling point of liquid cuprous chloride, 1632°K at 1 atm, the monomeric partial pressure is only 11%.

In the cuprous bromide and iodide systems evidence was found for the existence of polymer molecules in the vapor, but the actual polymer number was not evaluated.

The heats of formation of the various species at 1300°K and under standard conditions from the elements were found to be: CuCl(g), $\Delta H_{1300°K} = 18.8 \pm 4$ kcals; Cu_3Cl_3(g), $\Delta H_{1300°K} = -63.1 \pm 2$ kcals; and CuBr(g), $\Delta H_{1300°K} = 23.3 \pm 1.2$ kcals. The D_o values calculated from the thermal data were 3.80 ± 0.15 and 3.42 ± 0.15 volts for CuCl(g) and CuBr(g) respectively. Free energy equations are given for both cuprous chloride molecular species.

AECD - 1835 Studies on the Scattering of Neutrons by Protons, by L. Goldstein, 134 p., January 13, 1948. (LADC-497).

For publication in Physical Review.

With neutrons becoming available in an energy range which is still practically pre-relativistic and where presumably meson producing collisions are either excluded or of little importance, it was thought that a detailed study of neutron-proton scattering might be of multiple interest.

A quantitative analysis has thus been made of the scattering process in the energy interval of 9-144 Mev of absolute neutron kinetic energy. Spin dependence of the neutron-proton interaction is taken into account only insofar as the scattering process may take place in triplet and singlet states of the neutron-proton system. The space dependent interaction was assumed to have a well-shaped form with a radius equal to the classical electron radius of about 2.8×10^{-13} cm.

The general theory of scattering processes by central force fields is briefly reviewed and applied to the case of well-shaped potential energies, both with ordinary and exchange interactions.

The rigorous scattering phase shifts are studied in the whole energy interval. Of these phase shifts, the s, p, d and f-wave shifts turn out to be of importance, the latter near the high energy end of the energy interval under consideration.

The approximate phase shift formula is rederived with a somewhat more direct method than done previously. The approximate phase shifts of low angular momentum, even at high energies, differ considerably from the rigorous ones. Qualitatively they take into account the difference between ordinary and exchange interactions in a rather unsatisfactory way.

The rigorous differential scattering cross-sections are then evaluated. The characteristic scattering symmetries or asymmetries associated with the ordinary and exchange interactions are clearly brought out by these cross-sections.

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The angular distributions of the scattered neutrons or recoil protons are also studied with the approximation method. With this same method, the differential cross-sections resulting also from a scalar meson field potential are shortly discussed.

One of the main problems considered in this work was the study, within the frame of the semi-empirical neutron-proton interaction theory, of the limitations in the validity of the exchange interaction concept. This neutron-proton interaction type is criticized and some suggestions are advanced as to how to take into account these limitations. It is recalled that, while these limitations seem to result from the rather naive intuitive picture of the charge exchange mechanism, they appear to be included in the current meson field theoretical formalism. The latter leads, in higher approximations, to the intervention of ordinary interactions beside the exchange interaction which seem to become important at higher collision energies. The study of the limitations in the validity of the exchange interaction, at least within the frame of the semi-empirical theory, is rather of a highly speculative character.

Finally, the total scattering cross-sections are studied in some detail. It is shown that while at lower energies, the exchange type of interaction seems to be favored by the experimental data, at 90 Mev neutron energy the theoretical "exchange" cross-section is too large in comparison with the experimental one. The "ordinary" total cross-section is still larger than the "exchange" cross-section.

The approximate or Born total cross-section cannot take into account at all the difference between the ordinary and exchange types of interactions and fails significantly in this respect. The possible importance of the approximate methods in representing more correctly the average energy losses with both types of interactions than the total cross-sections is shortly touched upon finally.

AECD - 1836 **Measurements of Gamma-Ray Energies with the Beta-Ray Spectrometer, by E. N. Jensen, L. J. Laslett, and W. W. Pratt, 5 p., n.d., decl. 4/6/48.**

For oral presentation before a meeting of the Iowa Academy of Science to be held at Fairfield, Iowa, April 16, 1948, and also for possible publication in a technical journal.

An iron-free thin magnetic lens beta-ray spectrometer has been constructed. The spectrometer is mounted with its axis parallel to the earth's magnetic field.

The energies of the gamma-rays of Zn^{65}, Co^{60}, and Se^{75}, as determined by this investigation, are given below.

Gamma-Ray	Zn^{65} Mev	Co^{60} Mev	Se^{75} Mev
1	1.106	1.156	0.097
2		1.321	0.122
3			0.137
4			0.265
5			0.400

AECD - 1837 The Isotopes of Os^{185} and Os^{193}, by L. I. Katzin and M. Pobereskin, 14 p., January 1948. (ANL-HDY-420).

For publication in Physical Review.

The half-life of Os^{193} is shown to be 15.0 days, decay being by emission of a beta particle with range less than 35 milligrams per square centimeter of aluminum (energy not more than 0.165 Mev). A highly converted gamma ray of about 0.13 Mev energy is probably emitted at each disintegration, producing X-rays in large abundance. Os^{185} decays by orbital capture with a half-life of 100 days. A gamma ray of 0.75 Mev is probably emitted at each event. The relative cross-sections for pile (slow) neutron capture of the isotopes Os^{184}, Os^{190}, and Os^{192} have been estimated as 80:3.5:1, on the basis of measurements on the daughter activities.

AECD - 1838 Nuclear Reactions of Arsenic with 190 Mev Deuterons, by H. H. Hopkins, Jr. and B. B. Cunningham, 6 p., January 21, 1948. (UCRL-47).

For publication as a Letter to the Editor of Physical Review.

Isotopes formed in the bombardment of $_{33}As^{75}$ with 190 Mev deuterons range in atomic number up to twenty-four (or more) mass units lighter than As^{75}. Identification of these isotopes was based on chemical behavior and half-life determination. Relative yields have been calculated and show that 80% of the observed reactions produce isotopes within 8 mass units as As^{75}.

Three new isotopes have been observed: 9.5d Se^{72} (K), 44m Se^{71} (β^+), and 52m As^{71} (β^+).

AECD - 1839 Neutron Deficient Isotopes of Rhodium and Palladium, by M. Lindner and I. Perlman, 4 p., February 2, 1948. (UCRL-48).

For publication as a Letter to the Editor of the Physical Review.

A 9-hour palladium activity assigned to mass 101 and 4.0 day activity assigned to mass 100 have been identified.

The decay chains may be summarized as follows:

$$Pd^{101} \xrightarrow{9\ hr} Rh^{101} \xrightarrow{4.3\ day} Ru^{101}$$

$$Pd^{101} \xrightarrow{4.0\ day} Rh^{100} \xrightarrow{19.4\ hr} Ru^{100}$$

Cross sections for the formation of the palladium isotopes from rhodium with 50 Mev deuterons could only be approximated principally because of uncertainties in the deuteron beam strength and in the target geometry with undeflected beam. Values are based on yields of X-rays and relative to each other are probably considerable more reliable than the absolute values.

Product	Reaction	σ ($cm^2 \times 10^{24}$)
Pd^{103} (17-day	d,2n	0.0024
Pd^{101} (9-hr)	d,4n	0.24
Pd^{100} (4.0-day)	d,5n	0.28

*AECD - 1840 Hand Count Procedures at Clinton Laboratories, by H. M. Parker, 5 p., September 1944. (CH-1893).

For use as an aid in setting up personnel safeguards at Chalk River Laboratories.

The estimation of the radiation activity on the hands of personnel at Clinton Laboratories was put on an organized basis from the beginning. Initially beta and gamma counts were made by a G. M. counter method using a modified vertical tube shield assembly. Alpha ray activity was measured with a slightly modified linear amplifier chamber. After some months a special counter tube holder for hand counting for beta and gamma contamination was obtained. The early method required from 2 to 5 minutes for measurement of all surfaces of a pair of hands. To expedite the procedure a four-fold hand counter planned to evaluate the activity of all four surfaces of the hands in about 20 seconds was designed.

Descriptions of the original counter, box-type hand counter, and four-fold hand counter are given.

AECD - 1841 Corrections for the Resolution and Radiator Foil in the Beta Ray Spectrometer, by W. W. Pratt, L. J. Laslett, and E. N. Jensen, 7 p., n.d., decl. 4/6/48.

For oral presentation before a meeting of the Iowa Academy of Science to be held at Fairfield, Iowa, April 16, 1948, and also for possible publication in a technical journal.

When measuring gamma ray energies in a beta ray spectrometer it is necessary to take into account the effects of energy loss of the secondary electrons in the radiator foil and of the finite resolving power of the spectrometer. A method of determining these effects is discussed, assuming a triangular transmission curve and a rectangular momentum distribution of electrons emitted from the foil. Let P_m be the electron momentum before losing energy in the foil, P_{om} be the uncorrected momentum as measured by the spectrometer, K be the resolving power of the spectrometer, and a be the average momentum loss of electrons in passing through the entire foil. Then it is found that

$$\text{if } K P_{om} > \frac{a}{2} \qquad P_m = P_{om} + \frac{a}{2} \qquad \text{if } K P_{om} < \frac{a}{2} \qquad P_m = P_{om}(1+K).$$

*AECD - 1842 A Simplified Equation of State at High Pressures and Its Application to Surface Films on Liquids and Solids, by S. Ross and C. H. Secoy, 1 p., n.d., decl. 4/7/48.

For oral presentation at the Twenty-Second National Colloid Symposium to be held in Cambridge, Massachusetts, June 23-26, 1948.

This document is an abstract and is presented here in its entirety.

An empirical equation of state ascribed to Amagat is put into a form similar, but not equivalent, to that of van der Waals'. The useful application of this equation has been with films on liquid or solid surfaces. In its new form the equation is suitable for a ready integration of the Clausius' equation, leading to a method of estimating the latent heat of a two-dimensional phase transition. It is thus applied to previously published data for such transitions on liquid and solid surfaces, giving values that are sensibly constant throughout small ranges of temperature.

AECD - 1843 The Application of a Bent Crystal X-Ray Spectrograph to the Analysis of Radiations from a Radioactive Decay, by R. H. Stokes, 4 p., n.d., decl. 4/6/48.

For oral presentation before a meeting of the Iowa Academy of Science to be held at Fairfield, Iowa, April 16, 1948, and for possible publication in a technical journal.

A bent crystal spectrograph has been used to study the K capture decay of the 125d selenium isotope. Along with the K alpha X radiation of arsenic two other wavelengths were found.

One was a line of very nearly the same density as the arsenic line. It was on the long wavelength side about four-tenths of the way toward the K alpha radiation of the next highest atomic number. The other line was of comparatively low density and was close to the K alpha line of bromine.

AECD - 1844 Note on the "Natural Radioactivity of Rhenium", by N. Sugarman and H. Richter, 4 p., February 26, 1948. (ANL-NS-274).

For publication as a Letter to the Editor of Physical Review.

In examining the isobaric pair Re^{187}-Os^{187} for radioactivity, Naldrett and Libby found an activity in Re which they attributed to beta-radiations from Re^{187}. The samples were purified sufficiently to separate other elements with the exception of the chemically similar Tc. Since it appeared possible to the authors that the radiations observed might originate in a natural isotope of Tc present in the Re, the Re was subjected to chemical operations which were shown in tracer studies to free it of Tc, and then measured. The details of the chemical separation and the results of the activity measurements are given.

AECD - 1845 The Quantitative Determination of C^{14} Activity in Biological Systems by Direct Plating, by J. R. Hogness, L. J. Roth, E. Leifer, and W. Langham, 5 p., n.d., decl. 4/1/48. (LADC-504).

For publication in Science or the analytical edition of Industrial and Engineering Chemistry.

With the increased use of C^{14} tagged compounds in biological tracer studies a method for direct and rapid quantitative determination of radioactivity in biological fluids becomes important.

One satisfactory but tedious method involves combustion of the organic material in such fluids as blood, plasma, and urine, collection of the CO_2 and the precipitation on suitable plates as $BaCO_3$ according to the method described by Yankwich.

A more rapid method involves the direct plating of aliquots of the biological fluids themselves onto suitable counting plates and subsequent determination of radioactivity with a thin mica window G. M. tube.

In preparing calibration curves, increasing amounts of urine, plasma, or laked red cells were added to a series of tubes, each containing a known constant amount of a water solution of radioactive

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nicotinic acid. (C^{14} in the carboxyl group). The contents of each tube were thoroughly mixed and quantitatively transferred to copper discs (oxidized surface) which were rotated on a horizontal turntable during plating. The plates were dried with an infrared lamp and hot air blower, and counted using a G.M. tube with a thin mica window weighing 1.7 mg/cm^2 and having a diameter of 5.4 cm.

Since the effects noted were similar and reproducible for all biological fluids studied, (urine, plasma, laked erythrocytes) the results presented are representative.

AECD-1846 **Production of Mesons by the 184-Inch Berkeley Cyclotron, by E. Gardner and C. M. G. Lattes, 8 p., March 2, 1948. (UCRL-57).**

For publication in Science.

Tracks which are believed to be due to mesons were observed in photographic plates placed near a target bombarded by 380 Mev alpha particles. For a 10-minute exposure in the cyclotron, about 50 meson tracks were found along the 3-inch edge of a photographic plate. The mass has been determined by measuring the bending in the magnetic field and the range in emulsion. From the first 50 meson tracks measured, a mass of 313 ± 16 electron masses was found. It is highly probable that these mesons are the heavy mesons described by Lattes, Occhialini, and Powell.

AECD-1847 **High Sensitivity Apparatus for Fission Counting, by A. Ghiorso and W. C. Bentley, 17 p., September 1946. (ANL-JJK-14B-75).**

To be included in the NNES(MPTS).

In order to make the most of the thermal neutron fissionability tests, it was found necessary to develop radically new and different techniques for measuring fission recoil fragments. Since the isotopes that must be measured are for the most part obtainable in only very small quantities, i.e., less than a microgram, it is necessary to use very high neutron fluxes to secure reasonable counting rates. It was found early that a conventional fission chamber would not work properly at a high flux. The cause for failure was found to lie in the secondary radiation effects from the capture of neutrons by the materials which compose the chamber. It also soon became apparent that the metal walls of the chambers, usually aluminum (2S) or stainless steel, contained a large amount of fissionable contaminant. A third major problem that had to be contended with was the very large amount of induced radioactivity (β and γ) that was obtained with ordinary chambers when placed in a very high neutron flux.

A solution to all three troubles was obtained by constructing the fission chamber and accessories of lucite and bakelite with a minimum of metals exposed to the neutrons inside the thermal column. Necessary conducting surfaces were silvered with a quick-drying silver paint, which was found to be comparatively low in fissionable contaminants. A remote control loading and unloading mechanism for changing samples was developed. For this purpose the sample plates were fastened to silvered lucite disks which were then inserted into the chamber. Commercial argon was passed at atmospheric pressure through the chamber, the design of which was such that it could be quickly and easily replaced by another in case of accidental contamination. The pre-amplifier was housed in a cadmium shield placed about one foot from the chamber. The rest of the amplifier and scaler circuits were the conventional ones suited to fast electron collection.

The following drawings are included: cross-sectional drawing of removable fission chamber, cross-section of composite fission chamber showing some of construction details, pre-amplifier circuit, amplifier circuit, and sample changer.

AECD-1848 The Effect of Liquid Fluorine on Some Protective Gloves, by R. H. Lafferty, J. C. Barton, and J. A. Westbrook, 10 p., November 21, 1947. (K-71).

For publication in Industrial and Engineering Chemistry or in Chemical and Engineering News.

The effect of liquid fluorine on rubber, leather and cotton gloves is described. These tests were run to determine how much protection gloves would give from liquid fluorine. It was found that the rubber gloves burned actively in the fluorine, leather gloves smouldered, and cotton gloves exploded violently.

Pictures are presented to show the effect of the liquid fluorine cotton explosion on the laboratory equipment used in the experiment.

AECD-1849 Functional Description of the 184" Cyclotron Pulsed Arc System, by D. Mack, 20 p., July 1947. (BP-62).

Disposition as required for use in research, development, or manufacturing work, and for publication in a technical journal.

For the frequency modulated cyclotron to operate with a pulsed arc, it is necessary that the arc be initiated when the instantaneous frequency is descending through a particular value governed by the magnetic field strength. The 184" Pulsed Arc System meets this requirement by supplying a short rectangular pulse to the arc electrodes at any selected frequency within the descending frequency interval. All controls necessary for the operation of the system are on the pulse generator control unit located at the operating console. The arc pulse may be varied in length from 1 to 100 microseconds, and the range of frequency adjustment is sufficient to correspond with the degree of the frequency modulation of the cyclotron oscillator.

Drawings show the principal units and interconnections of the system. The operation of the Pulsed Arc Control Unit, the Pulse Amplifier, and the Beam Meter Amplifier, is described.

AECD-1850 Preliminary Report on the "Three Quarter Wave" R. F. System for Frequency Modulated Cyclotrons, by K. MacKenzie, 42 p., September 1947. (BP-140).

Disposition as required for use in research, development, or manufacturing work, and for publication in a technical journal.

This report covers the theory and model test results on a radio frequency system for a frequency modulated cyclotron as required for acceleration of 350 Mev protons. A rotating condenser is used at approximately one-third of the length of the dee line from the shorted end. It is shown to be possible to operate through the range of approximately 9 to 24 megacycles per second as required for the acceleration of either protons or deuterons in the 184-inch Berkeley cyclotron.

The advantage of this system is that the rotating condenser, which affects the frequency change, may be located outside the magnetic field and therefore avoid eddy current losses. In addition much more space is available, allowing a more rugged and serviceable unit. A further consideration which may turn out to be quite important, is that servicing and repairing the unit can be done without much danger of an overdose of radiation from a "hot" dee.

To offset this advantage it should be stated that the system is much more bulky than designs which employ a rotating condenser on the dee directly. It uses more power and has many more possible modes of oscillation.

AECD-1851 Uranium, Thorium, and Beryllium Melting and Fabrication, by J. F. Schumar, 13 p., March 23, 1948. (ANL-HDY-459).

For oral presentation before a meeting of the Chicago Technical Societies Council and for possible publication in a technical journal.

The difficulties encountered in casting these metals are listed,and the precautions taken against them discussed. Some of the mechanical properties of U, Th, and Be are given, and the methods of fabrication of each of the metals are outlined in some detail.

Because of their extreme reactivity with oxygen both beryllium and uranium are cast in a vacuum or under protection of inert gases. Beryllium has been successfully cast in dry and purified argon or helium atmospheres. On the other hand, uranium, which reacts with even small amounts of oxygen (that are difficult to remove from inert gases), is cast in a vacuum.

Seven photographs are included.

*AECD-1852 Preparation and Physical Properties of Uranium Hydride, by F. H. Spedding, et al., 44p., n.d., decl. 4/5/48.

To be included in the NNES(MPTS).

The preparation of uranium hydride is described and its composition shown to be given by the formula UH_3. It has a density of 10.95 g/cm^3 and has a simple cubic crystal structure with 8 uranium atoms per unit cell. Data for the equilibrium hydrogen pressure are given for temperatures between 250 and 430°C with -31,000 calories/mole as the heat of formation. The pressure-composition isotherm as well as other data indicates that uranium hydride is a true compound with no appreciable solubility for uranium or hydrogen.

Similar data are reported for uranium deuteride. Hydrogen-deuterium separation studies show that the decomposition of uranium hydride-deuteride mixtures gives low separation factors for hydrogen and deuterium.

AECD-1853 Half-Scale Model Tests on the Three Quarter Wave R. F. System for the 184-Inch Frequency Modulated Cyclotron, by R. L. Anderson, 30 p., December 30, 1947. (UCRL-31).

Disposition as required for use in research, development, or manufacturing work.

Performance curves and test results on a half scale model of the radio frequency system designed to accelerate protons in the Berkeley 184-inch cyclotron are presented. This report is a sequel to K.R. MacKenzie's report on the three quarter wave radio frequency system for frequency modulated cyclotrons. (AECD-1850).

Results of tests on the half-scale model show that the required frequency range may be covered on the full scale machine. If necessary the deuteron limit can be lowered by adding capacity to the dee. One of three things can be done to raise the upper proton limit, i.e., reduce the dimensions of the dee throat clearance, increase the dummy dee clearance, or insert stubs at the corners of the dee.

The transmission lines can be empirically adjusted to cover both proton and deuteron ranges without change, leaving only the phasing or grid to filament capacity as the variable.

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The power requirements are no greater than anticipated.

Performance of the model is considered sufficiently satisfactory to proceed with the full scale design and construction based on the model dimensions.

Photographs of different sections of the instrument are included.

AECD-1854 The Use of Anthracene as a Scintillation counter, by P. R. Bell, 5 p., n.d., decl. 4/9/48.

For publication as a Letter to the Editor of the Physical Review.

An abstract of this document has previously been issued as MDDC-1802 and listed in this journal.

AECD-1855 Self Delayed Coincidences with Scintillation Counters, by S. DeBenedetti, F. K. McGowan, J. E. Francis, Jr., and P. R. Bell, 3 p., n.d., decl. 4/9/48.

For publication as a Letter to the Editor of Physical Review.

It is possible to measure time intervals between two ionizing events by studying the distribution of pulses from a single detector provided the dead time of the detector is smaller than the interval to be measured. With scintillation counters, which supposedly have a very short dead time, the method of self delayed coincidences should be capable of measuring very short intervals.

To test this point a source of Hf^{181} (known to decay into Ta^{181*} of 22 μsec half-life) was located close to a clear anthracene sample (~.5 x 1 x 2 cm); on the opposite side, at a distance of 0.3 cm, was the glass wall of a 1P21 photomultiplier tube, operating at 60 volts per stage. The pulses from this tube, after amplification, were fed to a self delayed coincidence circuit. With this arrangement it was possible to measure the half-life of Ta^{181*} obtaining a value in good agreement with previous determinations.

In the following table counting rates (counts/min) of single counts and delayed coincidences (for the same source and with same delay and resolving times) are shown

	Geiger Counters	Anthracene Counters
Background (single counts)	~20	150
Single counts from source	9600	720
Delayed Coincidences	230	130

This indicates that anthracene scintillation counters are highly efficient, not only for the main radiation from Hf^{181}, but also for the radiation of Ta^{181*} which consists of electrons and gammas of around 100 Kev.

AECD-1856 A Pressure Ionization Chamber for the Measurement of Neutron Fluxes at Tolerance Level in Portable Instruments by G. Dessauer, F. A. White, and J. Rouvina, 17 p., October 16, 1945. (M-1773).

Disposition as required for use in research, development, or manufacturing work.

The largest daily fast neutron dose considered safe for the human body ("tolerance dose") is taken to be 0.01 n units. If this dose is received during an 8 hour working day, the neutron flux has to be such as to provide an average dose rate of 0.01 n units per 8 hours. An instrument of high sensitivity is needed to measure fluxes of such order of magnitude, in a reasonably short time and within a reasonably small space. High pressure ionization chambers as well as counters will serve the purpose. Which of the two should be chosen depends on what appears the most satisfactory compromise in fulfilling the following requirements: (1) The instrument should read as nearly proportional as possible to the biological effect, independently of the energy of the fast neutrons, (2) The instrument should have a high neutron to gamma sensitivity ratio, compared with the 100 r Victoreen chamber, and (3) The instrument should be of rugged and simple construction and require no accessories that would make the total weight in excess of what is conveniently portable.

A discussion of the following is included in the report: construction of pressure chamber, measurement of neutron doses, neutron sensitivity versus pressure, gamma sensitivity versus pressure, neutron-to-gamma sensitivity ratio, and sensitivity versus collecting voltage.

The construction of the pressure chamber is illustrated.

AECD-1857 Determination of Beryllium in Mouse Tissues, by R. Lesko, 11 p., January 1948. (ANL-HDY-443).

For publication in Analytical Chemistry.

The method which is a modification of the Fairhall method for the determination of beryllium in animal tissues, is based on the measurement of the orange red lake produced with quinizarin-2-sulfonic acid and beryllium in neutral ammonium acetate solution. The light absorption due to the orange red lake is best measured spectrophotometrically at 575 millimicrons.

Optimum conditions for the determination are the final pH of 7 for the solution which contains an optimum concentration of $NH_4C_2H_3O_2$ and dye, the period and temperature for warming, and the absence of interfering ions such as iron, zinc, fluoride, thiocyanate and phosphate.

The modifications introduced are the use of the Beckman Spectrophotometer for the measurement of the color intensity, and the purification of the quinizarin-2-sulfonic acid and selenous acid, the method for the color development and the procedure for the ashing of the animal tissues.

These modifications show that animal tissues may be ashed with no volatilization of beryllium and that the color desired can be controlled adequately to detect as little as 0.5 micrograms of beryllium in pure solution. The average precision and accuracy is $\pm$ 0.3 micrograms in the range of 1 to 18 micrograms of beryllium.

AECD-1858 Remodeling a Laboratory for Radiochemical Instruction or Research, by H. A. Levy, 10 p., n.d., decl. 4/13/48.

For oral presentation in the April meeting of the American Chemical Society and for publication in the Journal of Chemical Education.

Problems associated with adapting a laboratory to radiochemical work on the microcurie and millicurie level are discussed. These include the division of space among contamination and radiation levels; the desirable features of the individual work unit to promote cleanability, adequate segregation of equipment and prevention of contamination spread; the desirable features of a hot (<50 mC) facility; and the requirements of waste disposal and monitoring. Considerations involved in compromises of design are discussed.

AECD-1859 Color Production in Lithium Fluoride by Radiation, by R. A. Penneman, 17 p., March 1946. (ANL-HDY-461).

Disposition as required for use in research, development, or manufacturing work.

Crystals of synthetic lithium fluoride are colored by electron, X-ray, and pile radiation (neutron). The principal effect of pile radiation is caused by the Li^6 $(n,\alpha)H^3$ reaction, the α and H^3 particles having a total kinetic energy of~4.6 Mev. Qualitatively, the color depends upon the amount of irradiation, and progresses from a light green to a deep red on sufficient exposure. The absorption spectra of these crystals, colored by the various radiations, show discrete bands with peaks at 250, 310, 375, 445, and 550 mμ which are identical in position for the different irradiations, and are identified as F, R, R, M, and F'-bands. Heating at 300°C restores the original transmission.

AECD-1860 The Beta Spectrum of Os^{193}, by D. Saxon, 6 p., March 15, 1948. (ANL-HDY-462).

For publication in Physical Review.

The β spectrum of Os^{193} has been measured in the 180° β spectrometer. A sample of Os metal was irradiated in the Argonne heavy water pile. After allowing a month for the decay of the 32 hour activity, the spectrum was measured. To check for possible impurities, the decay was followed, giving half life of 16.1 ± 0.2 days, no impurities of other half lives being present. The source weight was 8.0 mg/cm^2, backed by 0.54 mg/cm^2 nylon. The GM tube window was 0.3 mg/cm^2 nylon. The resolution, $\frac{\Delta H\rho}{H\rho}$ used was 1%.

Discussions of the conversion lines and the Kurie plot of the Fermi theory are given. An upper limit is found for the neutrino mass.

* AECD-1861 A Note on the Use of Ion Exchange Resins for the Purification of Urinary Purines, Kynurenic Acid, and Coproporphyrin, by S. Schwartz, L. Wattenberg, and R. Zagaria, 16 p., July 1946. (CH-3759).

To be included in the NNES(MPTS).

Preliminary studies are reported on the use of ion exchange resins for the adsorption of purines, uracil, nucleotides, kynurenic acid, and coproporphyrin.

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Adenine and guanine are adsorbed on IR-100 resin from neutron solution and eluted by HCl.

Kynurenic acid and coproporphyrin are adsorbed from neutral solution on IR-4 resin and eluted by HCl. Coproporphyrin is strongly adsorbed on IR-100 resin from either acid, alkaline, or neutral solution. Kynurenic acid is poorly adsorbed on IR-100 resin from neutral aqueous solution.

The preliminary application of these procedures to the spectrophotometric study of urine is described.

AECD-1862 The Effects of Slow Neutrons from the Oak Ridge Pile on Tradescantia Chromosomes, by A. D. Conger and N. H. Giles, Jr., 6 p., n.d., decl. 4/13/48.

For oral presentation before a meeting of the Association of Southeastern Biologists to be held in Gainesville, Florida, April 16-17, 1948, and also for possible publication in a technical journal.

An abstract of this document has previously been issued as MDDC-1799 and listed in this journal.

AECD-1863 Thermodynamic Functions for Tritium and Tritium Hydride. The Equilibrium of Tritium and Hydrogen with Tritium Hydride. The Dissociation of Tritium and Tritium Hydride, by W. M. Jones, 17 p., January 26, 1948. (LADC-493).

For publication in the Journal of Chemical Physics or the Journal of the American Chemical Society.

The heat capacity, entropy, internal energy, and free energy are calculated to 2500°C for tritium and tritium hydride. The distribution of tritium between the ortho and para states is considered. The equilibrium constant for the formation of tritium hydride from hydrogen and tritium is calculated from 50 to 2500°K. The dissociation of tritium and tritium hydride into the atoms is discussed. The dissociation equilibria of hydrogen, deuterium, and deuterium hydride have been recalculated. The bearing of the radioactivity of tritium and tritium hydride on the attainment of thermodynamic equilibrium is briefly considered.

AECD-1864 The Hydrolytic Behavior of Uranium and the Transuranic Elements. I. The +5 and +6 Oxidation States, by K. A. Kraus and F. Nelson, 23 p., February 1948. (CNL-19).

For oral presentation at the April meeting of the American Chemical Society.

An abstract of this document has previously been issued as MDDC-1705 and listed in this journal.

AECD-1865 Summary Report on the Development of Electrometer Radiation Instruments, by O. G. Landsverk and E. O. Wollan, 29 p., July 25, 1944. (CP-1930 [A-2815]).

Disposition as required for use in research, development, or manufacturing work.

The document is a report on the characteristics and method of construction of the electrometer and on the various types of instruments which have been built around this electrometer unit. The report is divided as follows: (a) Construction techniques of the electrometer, (b) properties of the electrometer, and (c) types of instruments (gamma-ray survey meter, small gamma ray survey meter, pocket electrometer dosimeter, neutron-gamma ray survey meter, direct reading gamma ray survey meter, laboratory type gamma ray meter, alpha ray meter, and air tight pocket chamber and projection type electrometer unit).

AECD-1866 Installation of Chemical Research Laboratory, by H. Sheinberg and R. L. Thomas, 18 p., January 27, 1948. (LADC-494).

For publication in the Journal of the American Chemical Society.

A laboratory for research on plutonium processing methods has been installed. Provision is made for carrying out all work with radioactive material inside vented dryboxes. Equipment and space is adequate for five chemists.

A scale drawing showing approximate position of equipment and eleven photographs of apparatus used are included.

AECD-1867 Behavior of the Philips Ionization Gauge in Air, by M. Dole, 27 p., August 10, 1944, decl. 3/26/48. (RL 20.6.29).

For publication in a technical journal.

The purpose of this investigation was to study the response of the Philips Ionization Gauge as a function of voltage, size of ring, temperature, pressure and series resistance in regions of higher pressure than have hitherto been explored.

The results which are presented in the form of graphs may be summarized as follows: (a) The PIG current increases with an increase of pressure at constant voltage up to the highest pressures studied, 1×10^{-2} mm Hg. (b) The PIG current in the case of the A. C. studies, decreases approximately 10-fold as the series resistance is increased from 0.1 to 1 meg even at constant applied voltage (as measured by a full wave Cu_2O rectified voltmeter). (c) The PIG current at constant pressure and applied voltage decreases with a rise of temperature. (d) The pressure-sensitivity of the PIG is greater at the higher pressures in the case of the 1/4" ring and at the lower pressures in the case of the 1" ring.

It is concluded that: The PIG may be used for pressure measurements at least up to pressures as high as 1×10^{-2} mm Hg, the PIG is more nearly a gas density gauge than a pressure gauge, and the 1" ring is more generally applicable than a 1/2" or 1/4" ring.

It is recommended that: (a) A. C. power supplies rather than D. C. power supplies be used in PIG measurements. (b) One inch rings be used in the case of air-pressure measurements below 2μ, and

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1/4 inch rings above 2μ, or if only a ring of one size be used, the size be 1" for air pressure measurements. (c) The PIG data be expressed in terms of gas densities rather than gas pressures if the measurements are made at elevated temperatures unless the PIG has been previously calibrated in terms of pressure at this elevated temperature. (d) A 0.1 megohm series resistance be used for PIG pressure measurements in the high pressure range.

AECD-1868 Industrial Development of Atomic Energy, by H. Etherington, 16 p., n.d., decl. 4/13/48.

For publication in Machine Design.

Nuclear or atomic energy is developed in a reactor in the form of heat. This article indicates some of the engineering problems of extracting and applying the heat usefully and economically. The problems are complex, and a preliminary consideration of the nature of the fission process is given before the problems are discussed.

The problems of designing the first power reactor that are discussed are the kind of reactor, choice of materials for use in thermal reactors, radioactivity shielding, the heat exchange medium, fuel canning, chemical problems, mechanical problems, and control and instrumentation.

Continuing research is paving the way to successful development of an atomic power industry by expanding our knowledge of reactor characteristics by developing suitable materials and by contributing to the solution of many other problems. The engineering problems are neither trivial nor insuperable; they must be solved by engineering development proceeding concurrently with research. Components must of course be designed and tested but experimental reactors must also be built and operated before commerical atomic power can be a reality. The engineering development probably will take many years and a concentrated major effort must not too long await further study of fundamental problems.

*AECD-1869 The Recently Improved Slow Neutron Velocity Spectrometer with Some of the Results Obtained, by W. W. Havens, Jr., L. J. Rainwater, C. S. Wu, and J. R. Dunning, 1 p., March 8, 1948, decl. 4/13/48.

For publication in the Bulletin of the American Physical Society in connection with the April meeting of the Society, and for disposition as required for use in research, development, or manufacturing work.

This document is an abstract and is presented here in full.

The Columbia University Slow Neutron Velocity Spectrometer System has been improved by using a 1 m.c. crystal oscillator to provide the fundamental timing. This permits cyclotron and detector "on times" of 2, 4, 8, 16, etc., microseconds. Total cycle periods of 1024 or 8192 μ sec are used, depending on whether or not Cd filters can be used. Using 2 μsec "on times" and a 6 meter path length gives a total effective resolution width <1 μsec/meter. Since a time of flight of 0.72 μsec/meter corresponds to a neutron energy of 10,000 ev, it is now possible to observe strong neutron resonance levels above 1000 ev as sharp deep dips on a curve of slow neutron transmission vs time of flight. Results will be shown for Al, Zn, Cr, and NaBr, showing strong neutron resonance levels above 1000 ev.

*AECD-1870 Methods of Opacity Calculations, by H. Mayer, 152 p., October 31, 1947, decl. 4/9/48. (LADC-464).

Available for use as a thesis.

Methods for calculating the opacity of materials at high temperatures are discussed in this report. Minor improvements are outlined for the treatment of continuous absorption processes, and a small error usually made in treating the scattering process is corrected. In contrast to all previous calculations of opacity, the effect of line absorption is carefully examined, for it may well be the dominant process under certain conditions of temperature and density. Detailed methods for calculating the line absorption contribution are, therefore, developed. To illustrate the principles involved, the opacity of pure iron at a temperature of 1000 volts and normal density is worked out in detail. For this case, the opacity is 20.2 cm^2/gram, corresponding to a mean free path for radiation of 6.31×10^{-3} cm. The ratio of the opacity including line effects to the opacity without lines is 3.2.

*AECD-1871 Absorption Spectra of the Aqueous Tripositive, Radiation Laboratory, 2 p., n.d., decl. 4/9/48.

Available for use as slides with lectures and seminars.

This report consists of a photograph of the absorption spectra of the aqueous tripositive lanthanides (Ce, Pr, Nd, Sm, Eu, Gd, Tb) and actinides (U, Np, Pu, Am, Cm).

*AECD-1872 Beta and Gamma Radiations of Arsenic^{76}, by C. S. Wu, W. W. Havens, Jr. and L. J. Rainwater. 1 p., March 8, 1948, decl. 4/13/48.

For publication in the Bulletin of the American Physical Society in connection with the April meeting of the Society and will also be for informal disposition as required for use in research, development, or manufacturing work.

This document is an abstract and is presented here in full.

A source of arsenic, As^{76} obtained from the Oak Ridge pile was investigated, with respect to its beta and gamma rays, by the use of a helical focussing magnetic spectrometer and coincidence counting methods. Gamma-ray energies of the As^{76} were determined from photoelectric lines produced with a thin lead radiator and also from Compton electrons produced in brass. The energies of the stronger lines are 0.557 and 1.22 Mev. The weak one has energy 1.78 Mev. The beta-ray spectrum was measured with an extremely thin source on a backing of .08 μ Collodin film. Fermi plot of the data gives three groups with end points which agreed well with the energies of the gamma-rays determined. Beta-gamma coincidences were also measured. A scheme of disintegration will be proposed. A search for positrons put the upper limit of the number of positrons less than .1% of that of electrons.

AECD-1873 Amendments to Paper on "Short-Lived Halogen Fission Products", by N. Sugarman, 16 p., January 22, 1948, decl. 4/13/48. (ANL-NS-273).

For publication in the Journal of Chemical Physics.

This document consists of amendments to MDDC-1566.

The half-life of Xe^{137} was determined to be 3.9 ± 0.1 min by irradiation of Xe with neutrons.

Ten decay curves taken through 101, 211, and 311 mg Al/cm^2 yielded a half-life for Br^{85} of 3.00 ± 0.05 min. The β-energy was found to be 2.5 Mev by a Feather comparison method of the absorption curve of Br^{85} with that of the 1.5 Mev β-particles of the 17-min Se^{81}. γ-radiation is not present in high counting efficiency.

Half-lives found for I^{138} by two methods were 5.6 ± 0.1 sec and 6.5 ± 0.4 sec. The average half-life by weighting the first determination two-fold relative to the second is 5.9 ± 0.4 sec.

Since the adsorption factor for Xe and the fate of the Cs and Ba decay products of adsorbed Xe are unknown, the half-life found for I^{139} may be somewhat higher than the true value.

AECD-1874 Ranges in Air and Mass Identification of Plutonium Fission Fragments, by S. Katcoff, 19 p., February 18, 1948, decl. 4/13/48. (LADC-501).

For publication in the Bulletin of the American Physical Society.

An abstract of this document has previously been issued as AECD-1795, and listed in this journal.

AECD-1875 Opacity of Solar Material, by H. Mayer, 12 p., November 13, 1947, decl. 4/8/48. (LADC-465).

For publication in the Astrophysical Journal or the Physical Review.

It has recently been shown that line absorption may be an important process in calculations of the opacity of stellar matter. For this reason the opacity of a mixture of elements taken to represent the solar material has been recalculated. The line absorption increases the opacity by from 11 to 22%. The mixture of elements used has an appreciably greater proportion of heavy elements than the conventional Russell mixture, and so its opacity is about a factor 2.2 higher than those calculated by previous workers. The new opacities permit a redetermination of the hydrogen and helium content of the sun, with results of 42.5% and 49.9%, respectively, by weight. The central temperature of the sun is then 20.5 million degrees centigrade.

AECD-1876 Polarography with Solid Electrodes, by L. B. Rogers, H. H. Miller, R. B. Goodrich, and A. F. Stehney, 35 p., November 13, 1947, decl. 4/9/48. (MonC-236).

For oral presentation at the April meeting of the American Chemical Society, and for publication in Analytical Chemistry.

Contrary to what might have been predicted from the work of Laitinon and Kolthoff, well-defined and reproducible current-voltage curves can be obtained for silver ion using a stationary platinum

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micro-electrode and a continuously changing potential.

The half-wave potential of silver in a 0.1 N KNO_3 nitrate solution of pH 4.00 is independent of the direction of polarization, the rate changing the voltage, and the size of the electrode. It does, however, depend upon the concentration of silver ion according to predictions based upon the Nernst equation.

Stirring decreases the reproducibility of both the half-wave potential and the diffusion current. Stirring appears to produce a slight shift of the half-wave potential toward more negative potentials but the extent of the shift is barely larger than the experimental limits of error.

The diffusion current increases with the size of the electrode, the rate of polarization, and the speed of stirring. These observations can be used to extend the range of the method to more dilute solutions.

Stationary platinum electrodes give a linear relationship between diffusion current and concentration with an accuracy which allows the method to be used for semi-quantitative determinations.

A round maximum is usually obtained in quite solutions, the size of the maximum appearing to increase with electrode area and concentration of reproducible ion. The maximum may result from the time lag in reaching a state of diffusion equilibrium. No maxima were observed in stirred solutions.

Solid electrodes offer advantages over the dropping mercury electrode for analyses in the region of positive potentials, in solutions of hydrofluoric acid, and in solutions at low temperatures.

AECD-1877 Introductory Remarks, by J. A. Swartout, 4 p., n.d., decl. 4/13/48.

For oral presentation at the April meeting of the American Chemical Society, and for publication in the Journal of Chemical Education.

An abstract of this document has previously been issued as MDDC-1716 and listed in this journal.

AECD-1878 The Thermodynamics of Intermediate Uranium Fluorides from Measurements of the Disproportionation Pressures, by P. A. Agron, 27 p., n.d., decl. 1/16/48.

For publication in the Journal of the American Chemical Society.

The equilibrium disproportionation pressures of UF_6 over the following U-F compounds have been measured in the ranges indicated: α -UF_5 (100-200°C); β -UF_5 (100-152°C); U_2F_9 (225-320°C); and U_4F_{17} (270-350°C). In addition, the transition temperature and pressure of α - and β-UF_5 have been established at 125°C and 1.76 mm UF_6, respectively.

From measurements made and previous thermodynamic data of UF_4 and UF_6, the heats of formation, entropies, and free energies of these intermediate compounds are calculated.

AECD-1879 Isolation and Chemistry of Americium, by B. B. Cunningham, 10 p., February 1948, decl. 4/1/48. (ANL-JJK-124).

For oral presentation at the April Symposium of the American Chemical Society.

The isolation of the first pure compound of americium is described.

The properties of americium as determined by experiments with microgram quantities are summarized. The data include: (a) the specific alpha activity and half-life of Am^{241} (498 years) (b) the absorption spectrum of Am(III) and evidence concerning its relation to the spectra of other tripositive ions of the actinide and lanthanide elements, (c) evidence concerning the oxidation states of americium in various compounds and in solution, and (d) values for the solubility of americium compounds in various solutions.

AECD-1880 Radiations of UY, by G. B. Knight and R. L. Macklin, 10 p., October 27, 1947, decl. 4/20/48. (K-72).

For publication in Physical Review.

The radioactivity of UY (Th-231) has been re-investigated. Samples were prepared by growth from U-235 largely freed of U-238 and absorption, decay, and coincidence experiments were run. The presence of the 210 Kev beta ray was reconfirmed, and a 35 Kev gamma-ray 82% converted in the L shell was discovered. The half-life of UY was determined as 25.5 hours.

AECD-1881 Slow Neutron Spectrometer Studies of Oxygen, Nitrogen, and Argon, by E. Melkonian, L. J. Rainwater, W. W. Havens Jr., and J. R. Dunning, 7 p., February 5, 1948, decl. 4/7/48. (DR-1011).

To be included in the NNES(MPTS), and for publication as a Letter to the Editor of Physical Review.

The Columbia University Slow Neutron Velocity Spectrometer is being used to investigate materials in the gaseous phase. Preliminary measurements on several elements are presented in this note. All cross sections are in units of 10^{-24} cm^2/atom.

Measurements give the following cross sections per atom for the energy range 15 to 200 ev: O_2, 3.68; N_2, 9.74; A, 0.67.

AECD-1882 Cloud Chamber Measurements of Cadmium Capture Gamma Rays, by C. D. Moak and J. W. T. Dabbs, 8 p., n.d., decl. 4/20/48.

For oral presentation before a meeting of the American Physical Society to be held in Washington, D. C., and for publication in a technical journal.

An abstract of this document has previously been issued as AECD-1804 and listed in this journal.

AECD - 1883 The Exchange Adsorption of Ions from Aqueous Solutions by Organic Zeolites. V. Equilibrium and Rate Measurements on the Trivalent Rare Earths, by L. S. Myers, Jr., G. E. Boyd, B. H. Ketelle, and A. W. Adamson, 42 p., n.d., decl. 4/13/48.

For oral presentation at the April meeting of the American Chemical Society and for publication in the Journal of the American Chemical Society.

An experimental determination of the exchange adsorption of trivalent lanthanum, cerium and yttrium from 0.1 M hydrochloric acid solutions by Amberlite IR-1 gave the following sequence of adsorption affinity: $La^{+++} > Ce^{+++} > Y^{+++}$.

Measurements of the rate of exchange of the trivalent rare earth cations showed that either a film or a particle diffusion rate process controlled, depending upon the magnitude of the equilibrium distribution coefficient and on the adsorbent particle diameter. The transition from a film process to particle diffusion occurred in the concentration range: 0.2 - 0.5 M with ammonium perchlorate solutions. The same transition occurred around 0.01 M with hydrochloric acid solutions for the exchange of the univalent alkali metal cations.

The rates of the exchange adsorption of La(III), Ce(III) and Y(III) from 0.1 M hydrochloric acid solutions were approximately one-thousand times smaller than those for the univalent alkali metal cations under the same circumstances.

The presence of citric acid in 0.5 M ammonium perchlorate solutions maintained at pH of 2.6 was shown to increase the rate of exchange of trivalent yttrium ion. At these electrolyte concentrations and with 40/60 mesh adsorbent, the rate mechanism was always that of diffusion in and through the exchanger.

*AECD - 1884 Assay Procedures for Uranium Using Ether Extraction, Electrolysis and Cupferron Precipitation, by E. L. Zebroski and B. M. Tolbert, 24 p., n.d., decl. 3/16/48. (BC-10).

To be included in the NNES(MPTS).

A general assay method for uranium in the presence of copper, chromium, iron, cobalt, nickel, titanium, vanadium, magnesium, calcium, aluminum, bismuth, and phosphorus is presented. The procedure consists of ether extraction, electrolysis, and a double cupferron precipitation. Purity of the product averages 99.8%. The standard deviation for 13 samples was 0.42 mg or 0.38%, and the apparent recovery 100.0%.

An efficient ether extractor which permits quantitative recovery of uranium from suitable nitrate solutions in about 20 minutes is described.

A new method for carrying out a double cupferron precipitation using $Na_2S_2O_4$ as a reducing agent is described.

Five alternative methods of uranium assay are described for samples with varying amounts and types of impurities: (1) An ether extraction, electrolysis and ammonia precipitation process for copper samples; (2) An ether extraction-double cupferron is outlined for samples containing copper, nickel or chromium; (3) A formic acid destruction of nitrates, electrolysis-single cupferron procedure for stainless steel impurities; (4) A double cupferron precipitation for alkali metals and alkaline earth impurities; and (5) A double ether extraction for samples not containing phosphate are described.

AECD - 1885 On the Radioactive Decay of the Neutron, by A. H. Snell and L. C. Miller, 7 p., n.d., decl. 4/13/48.

For oral presentation at the American Physical Society April 29 through May 1, 1948.

An abstract of this document has previously been issued as MDDC - 1807 and listed in this journal.

AECD - 1886 The Impact of Radioactivity on Chemical Laboratory Techniques and Design, by P. C. Tompkins and H. A. Levy, 13 p., n.d., decl. 4/15/48.

For oral presentation at the April meeting of the American Chemical Society and for publication in the Journal of Chemical Education.

An abstract of this document has previously been issued as MDDC - 1719 and listed in this journal.

AECD - 1887 Problems Encountered in the Design of a Radioisotope Processing Building, by P. C. Tompkins, 22 p., n.d., decl. 4/20/48.

For oral presentation at the April meeting of the American Chemical Society and for possible publication in a technical journal.

An abstract of this document has previously been issued as MDDC - 1771 and listed in this journal.

AECD - 1888 The Hydrolytic Behavior of Uranium and the Transuranic Elements. II. The +3 and +4 Oxidation States, by K. A. Kraus and F. Nelson, 22 p., n.d., decl. 4/15/48. (ORNL-23).

For oral presentation at the April meeting of the American Chemical Society, and for possible publication in a technical journal.

An abstract of this document has previously been issued as MDDC - 1705 and listed in this journal.

AECD - 1889 Scintillation Counting with Anthracene, by P. R. Bell and R. C. Davis, 10 p., n.d., decl. 4/20/48.

For oral presentation before a meeting of the American Physical Society to be held in Washington, D. C., and for possible publication in a technical journal.

An abstract of this document has previously been issued as MDDC - 1802 and listed in this journal. For related material see AECD-1854.

AECD - 1890 The Absorption Spectra of Transuranic Salts in Crystals, by S. Freed and F. J. Leitz, Jr., 6 p., March 1948, decl. 4/15/48. (ANL-JJK-137).

For oral presentation at the April 1948 symposium of the American Chemical Society and for possible publication in a technical journal. See also MDDC-1700.

Absorption spectra, mainly in the visible and near ultraviolet regions, were taken of the following anhydrous salts at room temperature and at that of liquid nitrogen: uranium tetrachloride, neptunium tetrachloride, americium trichloride (and americium tribromide).

The spectra of these salts have the features characteristic of rare earth spectra, sharp lines clustered in groups. It follows that the heavy elements have their least stable electrons within the inner 5f shell when their ions are in activated as well as in their basic electronic states.

The spectra of the salts of americium are among the sharpest known from crystals even at room temperature. In this respect they are matched as far as we know, only by the salts of trivalent europium ion. The spectra confirm the resemblance drawn between these ions on other grounds and make it very likely that trivalent americium has six electrons in the 5f shell with $^7F_0$ for its basic electronic state.

AECD - 1891 The Preparation of Actinium Compounds, by S. Fried and F. Hagemann, 8 p., January 29, 1948, decl. 4/15/48. (ANL-JJK-14B-121).

For oral presentation at the April 1948 symposium of the American Chemical Society.

Eight compounds of actinium (AcF_3, $AcCl_3$, $AcBr_3$, AcOCl, AcOBr, Ac_2S_3, Ac_2O_3, and $AcPO_4 \cdot \frac{1}{2}H_2O$) have been prepared and positively identified.

Attempts to prepare the iodide, hydroxide, oxalate, oxyfluoride and the double salt with potassium sulfate failed either in that no X-ray diffraction pattern was obtained or that it had not yet been interpreted.

The compounds that have been identified are all isomorphous with the corresponding lanthanum compounds.

The methods of preparation are similar to those employed for other heavy metals and lanthanum.

No indication of any valence number other than three was observed.

AECD - 1892 Oxides of Transuranium Elements, by D. M. Gruen and J. J. Katz, 9 p., March 1948, decl. 4/15/48. (ANL-JJK-139).

For oral presentation at the April 1948 symposium of the American Chemical Society, and for possible publication in a technical journal.

An abstract of this document has previously been issued as MDDC-1737 and listed in this journal.

AECD - 1893 **Ionic Species of Plutonium Present in Aqueous Solution of Different Acids, by J. C. Hindman, 34 p., March 1948, decl. 4/15/48. (ANL-JJK-141).**

For oral presentation at the April 1948 symposium of the American Chemical Society, and for possible publication in a technical journal.

An abstract of this document has previously been issued as MDDC-1757 and listed in this journal.

AECD - 1894 **Heavy Metal Borohydrides, by H. R. Hoekstra and J. J. Katz, 8 p., March 1948, decl. 4/15/48. (ANL-JJK-140).**

For oral presentation at the April 1948 symposium of the American Chemical Society and for possible publication in a technical journal.

The preparation of uranium borohydride and observation of its properties aroused considerable interest in other heavy metal borohydrides. Using essentially the same methods employed in the preparation of uranium borohydride, the borohydrides of thorium, neptunium, and plutonium have been prepared. Since aluminum borohydride was used as one of the reactants in each instance, the reactions were of necessity carried out in vacuo, using approximately the standard vacuum line set-up developed by Stock and his co-workers in Germany and by Schlesinger in Chicago.

Thorium borohydride (a crystalline white solid melting at 204°C) was prepared by treatment of anhydrous thorium fluoride with aluminum borohydride. It is less volatile than the uranium borohydride, its vapor pressure at 150°C being about 0.2 mm. It is, however, the most volatile thorium compound known. Investigation of the X-ray diffraction pattern showed that the structure of $Th(BH_4)_4$ is very similar to that of the uranium compound. Both are orthorhombic. Thorium borohydride can be exposed to air, and in small amounts, even be dropped into water without exploding.

Neptunium borohydride was prepared from its tetrafluoride, and the formula of the substance obtained was calculated to be $Np(BH_4)_4$.

X-ray analysis of the product obtained in the preparation of the plutonium borohydride from PuF_4 failed to reveal whether the compound was a Pu(III) or Pu(IV) borohydride.

The hafnium compound was prepared from the fluoride, while the Zr and Ti compounds were prepared from the respective chlorides. Hafnium and zirconium borohydride are low melting (28-30°C) crystalline solids having vapor pressures of about 15 mm at room temperature.

AECD - 1895 **Paramagnetism and Electronic Structure of Aqueous Ions of Elements 92 to 95, by J. J. Howland, Jr. and M. Calvin, 10 p., March 1, 1948, decl. 4/15/48. (ANL-JJK-130).**

For oral presentation at the April 1948 symposium of the American Chemical Society.

In this paper it is shown that the configuration of the electrons in incomplete shells for the aqueous actinide ions from Np(VI) to Am(III) must be $(5f)$.$^{1-6}$ Assumption of configurations of the types $(6d)^{1-6}$ or $6d(5f)^{1-5}$ would generally fail to explain the observed magnetic susceptibilities of solutions of these ions.

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If the electrons in unfilled orbitals are influenced only slightly by neighboring atoms (5f's are shielded by a $(6s)^2$ $(6p)^6$ shell) then the macroscopic paramagnetism of solutions can be quantitatively deduced from the electronic structure of the central atom in the ion. In some examples the converse, deduction of the structure from the susceptibility, should be possible.

The magnetic susceptibilities of solutions of U(IV), Np(IV), Np(V), Np(VI), Pu(III), Pu(IV), Pu(VI), and Am(III) were measured on 0.1 ml samples in a divided glass capillary which was suspended. The capillary moved horizontally 0.01 to 0.2 cm when the field of 17,000 Gauss was applied.

AECD - 1896 Magnetic Susceptibilities of Some Uranium and Neptunium Compounds, by C. A. Hutchison, Jr. and N. Elliot, 11 p., March 1948, decl. 4/15/48 (ANL-CAH-10).

For oral presentation at the April 1948 symposium of the American Chemical Society and for possible publication in a technical journal.

An abstract of this document has previously been issued as MDDC-1702 and listed in this journal.

AECD - 1897 Studies on the Chemistry of Protactinium, by R. Thompson, 10 p., February 1948, decl. 4/15/48. (ANL-JJK-123).

For oral presentation at the April 1948 symposium of the American Chemical Society.

An abstract of this document has previously been issued as MDDC-1770 and listed in this journal.

AECD - 1898 The Preparation and Isolation of Curium, by L. B. Werner and I. Perlman, 9 p., March 1948, decl. 4/15/48. (ANL-JJK-129).

For oral presentation at the April 1948 symposium of the American Chemical Society and for possible publication in a technical journal.

An abstract of this document has previously been issued as MDDC-1772 and listed in this journal.

AECD - 1899 The Thermodynamics of the Actinides, by L. Brewer, 10 p., February 10, 1948, decl. 4/15/48. (ANL-JJK-131).

For oral presentation at the April 1948 symposium of the American Chemical Society and for possible publication in a technical journal.

An abstract of this document has previously been issued as MDDC-1722 and listed in this journal.

AECD - 1900 Glossary of Atomic Energy, by I. A. Warheit and C. Bramblett,145p., May 3, 1948, decl. May 11, 1948.

Disposition as required for use in research, development, or manufacturing work.

A glossary of over 900 terms has been collected by the Technical Information Division, ORDO, in the course of abstracting research and development reports and published and unpublished literature of atomic energy. References are cited for most of the definitions.

AECD - 1901 Fraunhofer Diffraction Pattern Produced by a Slit of Varying Width and Its Application to High Speed Cameras, by F. E. Geiger, 12 p., November 11, 1947, decl. 4/20/48. (LADC-468).

Disposition as required for use in research, development, or manufacturing work.

A theoretical and experimental investigation is made of the diffraction pattern produced by a slit, whose aperture varies uniformly from a constant value A to zero. The results of this investigation are applied to a proposed high speed camera. It is shown that diffraction effects are very serious and cannot be neglected. It seems, unless the suggested design of this high speed camera is changed, the camera will be of little use for accurate measurements, and photographs will show too much blur to give details.

AECD - 1902 The Masses of the Heavy Isotopes, by M. O. Stern, 20 p., March 3, 1948, decl. 4/23/48. (UCRL-61).

For publication in the Physical Review.

Radioactive decay data are used to calculate the atomic masses of the heavy isotopes, $A \geq 202$. The data have been critically surveyed; in some cases they have been supplemented by construction of tentative energy level schemes or by estimates of decay energies. With the adoption of certain assumptions a connection between the different radioactive families is made possible. The masses thus obtained have been tabulated and plotted. A certain regularity and periodicity in the plot is observed. From atomic weight 210 on, the Weizsaecker-Fermi formula is found to become increasingly unsatisfactory for the calculation of the masses, results deviating by as much as 0.020 mass units from those obtained by experimental data.

AECD - 1903 Thermochemical Measurements on the Transuranium Elements, by E. F. Westrum, Jr., 16 p., March 1948, decl. 4/15/48. (ANL-JJK-133).

For oral presentation at the April 1948 symposium of the American Chemical Society and for possible publication in a technical journal.

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An abstract of this document has previously been issued as MDDC-1773 and listed in this journal.

*AECD - 1904 Magnetic Field of an Interrupted Solenoid, by E. U. Condon and R. R. Dempster, 14 p., December 17, 1943, decl. 4/22/48. (RL 27.6.34).

Disposition as required for use in research, development, or manufacturing work, and for possible publication in a technical journal.

This report contains the derivation of a general expression for the field within an interrupted solenoid. Values of the field variation are given for one feasible coil geometry.

The total variation of the z-component of the field. as a function of radius is given. The case involved is the physically feasible coil geometry, namely, coils of finite depth, and two equal gaps in the distance L. The tabulated variations all have a z-periodicity of 0.5 L.

The maximum angle between the field and the z axis at r = 0.7 L is 0° 57', for the case of coils of finite depth and two gaps in the distance L. The maximum angle will be less than this value for smaller values of r.

AECD - 1905 Packing Fraction Measurements of the Heavy Elements, by A. J. Dempster, 4 p., March 1948, decl. 4/22/48. (ANL-AJD-237).

For oral presentation before a meeting of the American Physical Society, and for possible publication in a technical journal.

An abstract of this document has previously been issued as MDDC-1776 and listed in this journal.

AECD - 1906 Design of Radiochemistry Laboratories for Research with Low Levels of Radioactivity, by J. A. Swartout, 17 p., n.d., decl. 4/20/48.

For oral presentation at the April 1948 symposium of the American Chemical Society, and for possible publication in a technical journal.

An abstract of this document has previously been issued as MDDC-1717 and listed in this journal.

AECD - 1907 The Tracer Chemistry of Americium and Curium, by S. G. Thompson R. A. James, and L. O. Morgan, 6 p., January 21, 1948, decl. 4/23/48. (ANL-JJK-122).

For oral presentation at the April 1948 symposium of the American Chemical Society, and for possible publication in a technical journal.

An abstract of this document has previously been issued as MDDC-1718 and listed in this journal.

AECD - 1908 Some Applications of Electronics to Precision D. C. Measurements and Control, by H. T. Gittings, 9 p., January 23, 1948, decl. 4/22/48. (LADC-503).

For publication in Review of Scientific Instruments.

There has been some interest recently in control and measuring circuits capable of greater precision than the standard circuits now in use. It is the purpose of this report to set forth in preliminary form a system which has had several successful applications to date and which warrants further research and development. The circuits presented are schematic and the details vary quite a bit from case to case.

While it is practically impossible to build a stable direct-coupled amplifier relying on vacuum tube characteristics alone, a stable system can be set up with a high-gain d.c. amplifier as one component. In such a setup, which is essentially completely degenerative, the amplifier acts only to keep a balanced condition and changes in amplifier characteristics are almost perfectly self-compensated.

AECD - 1909 Exchange Reactions of Uranium Ions in Solution, by E. Rona, 14 p., March 1948, decl. 4/20/48. (ANL-JJK-142).

For oral presentation at the April 1948 meeting of the American Chemical Society, and for possible publication in a technical journal.

An abstract of this document has previously been issued as MDDC-1730 and listed in this journal.

AECD - 1910 The Radiocolloidal Properties of Some Fission Products, by J. Schubert, 21 p., February 11, 1948, decl. 4/20/48. (ANL-HDY-460).

For oral presentation at the April 1948 symposium of the American Chemical Society, and for possible publication in a technical journal.

An abstract of this document has previously been issued as MDDC-1744 and listed in this journal.

AECD - 1911 The Estimation of Heats of Formation, by L. Brewer, 11 p., February 2, 1948, decl. 4/28/48. (UCRL-49).

To be included in the NNES(MPTS), and for disposition as required for use in research, development, or manufacturing work.

It is often possible to estimate values for the heats of formation of compounds from related thermodynamic data. Although such estimates cannot usually be made with high accuracy, data of considerable value can often be obtained.

As an illustration of this method, the heats of formation of some compounds of Th, Np, and Am are estimated. The procedure is particularly suited for lanthanide and actinide elements because of the similarity of the ionic radii and types of bonding.

AECD - 1912 The Path of Carbon in Photosynthesis, by M. Calvin and A. A. Benson, 12 p., March 8, 1948, decl. 5/5/48. (UCRL-65).

For publication in Science.

The dark fixation of carbon dioxide by green algae has been investigated and found to be closely related to photosynthesis fixation. By illumination in the absence of carbon dioxide followed by treatment with radioactive carbon dioxide in the dark, the amount fixed has been increased ten to twenty fold. This rate of maximum fixation approaches photosynthesis maximum rates. The majority of the radioactive products formed under these conditions have been identified and isolated and the distribution of labeled carbon determined. From these results a tentative scheme for the mechanism of photosynthesis is set forth.

AECD - 1913 Concentration of Isotopes of Mercury in Countercurrent Molecular Stills, by S. L. Madorsky, P. Bradt, and S. Straus, 21 p., n.d., decl. 5/5/48.

For publication in the Journal of Research of the National Bureau of Standards.

Mercury was refluxed in countercurrent molecular stills in order to concentrate Hg^{204}. Two glass stills, with heater and cooler placed outside the distillation columns, and one still, consisting of a glass column heated externally and stainless steel cooler placed concentrically inside the column, were used. As compared with a 10-cell steel column described previously (MDDC-709), these columns showed poor performance mainly because the hold-up was too small. There are definite indications, however, that with liquids having a lower surface tension than Hg, these columns will perform as well as the 10-cell steel column. Mass spectrometer analysis of isotope ratios of the Hg isotope concentrates were in good agreement with density determinations.

Two diagrams of the glass column for the concentration of isotopes of mercury are included.

AECD - 1914 Metabolism of Plutonium in the Rat, by W. H. Langham, 40 p., May 1, 1946. (LADC-472).

Disposition as required for use in research, development, or manufacturing work.

This report gives a comprehensive summary of the project literature dealing with the absorption, excretion, and body deposition of plutonium when administered in various forms and by various routes to the rat.

Additional experimental data are presented regarding the metabolism of plutonium when administered to the rat by intravenous injection. The results indicated the following:

1. The first day following intravenous injection of $PuO_2(NO_3)_2$ the urinary excretion of plutonium was 7.5 per cent of the dose as compared to 0.33, 0.57, and 0.71 per cent when administered as $PuCl_3$, $Pu(NO_3)_4$, and Pu^{+4} citrate complex, respectively. Fecal excretion during the first day was correspondingly lower following injection of $PuO_2(NO_3)_2$. On the thirtieth day following intravenous injection there were no significant differences in either urinary or fecal excretion of plutonium administered as $PuCl_3$, $Pu(NO_3)_4$, Pu^{+4} citrate complex, and $PuO_2(NO_3)_2$. At this time the average urinary excretion

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was 0.014 per cent of the injected dose and the average fecal excretion was 0.22 per cent. The average ratio of fecal to urinary excretion was 16/1. Urinary and fecal excretion curves are given for all forms of plutonium injected.

2. The skeleton was the principal site of deposition regardless of the form in which the plutonium was injected. Four days following injection of plutonium as $PuCl_3$, $Pu(NO_3)_4$, Pu^{+4} citrate complex, and $PuO_2(NO_3)_2$ skeletal deposition was 44.9, 29.3, 56.9, and 56.5 per cent of the injected dose, respectively. Deposition in the liver under the above conditions was 22.9, 39.7, 9.6, and 9.1 per cent of the injected dose, respectively. Deposition of plutonium in kidney, spleen, and in "balance" was not greatly affected by the form in which the plutonium was administered.

3. The size of the injected dose of Pu^{+4} citrate complex did not affect the per cent of the dose excreted in the feces and urine. Likewise, the size of dose did not alter the per cent of injected material present in the various tissues six days following injection.

4. When Pu^{+4} was administered orally in 5 per cent sodium citrate solution, the presence of the citrate seemed to increase absorption of the plutonium from the gastro-intestinal tract. Absorption was still quite low--only 0.3 per cent of the administered dose.

Seventy-eight per cent of the plutonium absorbed from the gastro-intestinal tract was deposited in the skeleton and 7.3 per cent in the liver. Body deposition of plutonium absorbed via this route seems to resemble that of plutonium injected intravenously as $PuO_2(NO_3)_2$ or Pu^{+4} citrate complex.

AECD - 1915 The Deposition of Uranium in Bone. I. Animal Studies, by W. F. Neuman, M. W. Neuman, E. R. Main, and B. J. Mulryan, 11 p., February 1948. (M-2014).

To be included in the NNES(MPTS), and for publication in the Journal of Biological Chemistry.

The age of the rat proved to be an important factor in determining the extent of uranium-deposition in bone. The young, more rapidly growing animals irrespective of sex showed a greater fixation of injected uranium. A comparison of different parts of femur also showed a direct correlation between growth activity and uranium-fixation.

There seems reason to doubt, however, that the deposition of uranium is directly related to the calcification process per se. Rather, it appears more likely that some factor closely associated with bone growth, vascularity, perhaps, is responsible. For example, in the rachitic animals, large amounts of uranium were found in bones where no net accretion of mineral was taking place. Radiophosphate, the fixation of which has been established to be principally an exchange process not directly associated with growth, showed the same relative distribution as did uranium. Finally, it has been shown that uranium is cleared from blood within 45 minutes after injection. During this time, the amount of new calcification is so small that,to account for uranium-deposition as part of the calcification process, nearly every mole of hydroxyl apatite laid down must bind a uranyl ion. At the concentrations of uranium in the plasma during this period, such a phenomenon seems improbable.

It has been reported that uranium is deposited principally in the periosteum and endosteum. Direct analyses of periosteum did not confirm this view.

AECD - 1916 The Deposition of Uranium in Bone. II. Radioautographic Studies, by W. F. Neuman and M. W. Neuman, 9 p., February 1948. (M-2015).

To be included in the NNES(MPTS), and for publication in Archives of Biochemistry.

Radioautographs of bone containing U^{233} showed this element to be deposited only in the mineral portions and to be particularly concentrated on surfaces adjacent to the circulation and calcification. Once fixed, little redistribution of uranium occurred. As the normal growth and calcification processes continued, new bone accumulated over the lines of deposition and the resorption of bone to some extent was inhibited, probably because of the insolubility of uranium-impregnated bone salt.

AECD - 1917 The Deposition of Uranium in Bone. III. The Effect of Diet, by W. F. Neuman, M. W. Neuman, E. R. Main, and B. J. Mulryan, 10 p., February 1948. (M-2016).

To be included in the NNES(MPTS), and for publication in the Journal of Biological Chemistry.

The effect of several experimental diets on the rate of mobilization of skeletal uranium in rats was tested. Alkaline and acidic diets were without effect; a rachitogenic diet increased the rate of mobilization.

Nearly one-half of the uranium originally deposited disappeared in the 7 week dietary period. If the femurs and humeri are assumed to be representative of the skeleton as a whole, the half-life of skeletal uranium in the rat must be of the order of fifty to sixty days. This would correspond, on a logarithmic basis, to an excretion rate of slightly over 2 per cent per day.

*AECD - 1918 The Toxicity of Uranium Hexafluoride Fume in Animals Exposed for One Year to 0.05 and 0.2 mg U/m^3, Respectively, by C. J. Spiegl, 65 p., February 1948. (UR-4).

To be included in the NNES(MPTS).

Groups of animals were exposed to the fumes of UF_6 in air in order to evaluate chronic toxicity and to estimate a "maximal tolerated concentration". One month was used for acclimatizing the animals and for establishing control biochemical values. For the next successive 12 months, 21 dogs, 185 rats, and 16 rabbits were exposed to 0.2 mg U/m^3; 17 dogs, 179 rats, and 30 guinea pigs to 0.05 mg U/m^3. Rabbits and guinea pigs were studied during only the last 9 months. Daily exposure in both studies lasted 6 hours, except for alternate Saturdays.

Only borderline toxicity was produced by 0.2 mg U/m^3 and almost no effects by 0.05 mg U/m^3. Mortality of all species was 14.3 per cent and below that of a similar control group. Exposed dogs showed small weight losses but quickly returned to normal. Although the frequency of elevated blood nonprotein nitrogen levels as well as abnormal urinary protein and amino acid to creatinine ratios in dogs and in rabbits was greater than among controls; these deviations occurred at random throughout the year. Hematologic changes in dogs and rats were not significant.

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Exposure to UF_6 at 0.2 mg U/m^3 produced slight but definite changes in the prothrombin clotting time and blood fibrinogen levels of dogs, rats, and rabbits, although no pathologic changes were found in the liver. Mild renal tubular injury was produced in 12 of 14 dogs within 10 days. and in 55 per cent of the rabbits and 16 per cent of the rats, respectively. Fluoride, but not uranium was found deposited in the bones of rats. Alveolar bone changes were pathognomonic of fluorosis although dental studies of incisors showed only slight pigmentary changes. Except for 2 of 17 dogs and 1 of 141 rats, there was no evidence that 0.05 mg U/m^3 produced any morphologic changes.

*AECD - 1919 Uranium Tetrafluoride. Two One-Year Inhalation Toxicity Studies of Animals at 3.0 and 0.5 mg/m^3, Respectively, by A. Rothstein. 41 p., February 1948. (UR-7).

To be included in the NNES(MPTS).

One year of exposure to inhalation of 3 mg of U/m^3 as UF_4 dust resulted in definite but mild signs of toxicity in some animals of each of 4 species, the dog, the rabbit, the guinea pig and the rat, but a similar one year of exposure to 0.5 mg of U/m^3 as UF_4 resulted in no observable signs of toxicity in dogs and barely detectable signs in only 4 of 105 rats. The toxic effects were related to mild renal changes similar to those found in previous 30-day studies.

No deaths, alterations in growth rate, hematological counts, blood NPN, urinary protein, or dental fluorosis attributable to exposure to U were observed. There was, however, an elevation of the urinary ratio of amino acid to creatinine of rabbits and there was storage of U in bones, lung, kidney and pulmonary lymph nodes.

AECD - 1920 Some Aspects of Carbohydrate Metabolism in Normal Animals and in Animals Poisoned with Uranyl Nitrate, Hydrogen Fluoride, and Alloxan, by C. Bishop and E. Roberts, 59 p., February 1948. (UR-10).

To be included in the NNES(MPTS), and for publication in the Journal of Biological Chemistry.

Exposure to uranium compounds produces alterations in carbohydrate metabolism of dogs and rats.

A group of rats was exposed to an atmosphere containing 19 mg of uranium nitrate/m^3. In both non-fasted and fasted rats, normal glucose levels and normal liver and muscle glycogen percentages were found. Only when fasted rats were given a dose of glucose intraperitoneally, were the variations from the normal conditions discovered. Although normal liver glycogen formation occurred, muscle glycogen formation was considerabley reduced, and in consequence the body glucose level was very high.

In another series of rats with the same exposure, fasted animals were found to excrete more urinary glucose than did normal fasted rats. Peculiarly enough, these rats, after an injection of glucose, excreted approximately the same amount as they did without glucose injections; whereas, normal un-exposed rats exhibited increased glycosuria following an injection of glucose.

When dogs were exposed to an atmosphere containing 1.2 mg of uranium nitrate, the glucose tolerance curves obtained after exposure were not highly abnormal, but did show a slow returen to normal fasting glucose levels. These dogs excreted glucose in urine and protein in the urine during the second

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week of exposure. When $NaHCO_3$ was administered in the recovery phase a more normal glucose tolerance curve was obtained. This may be ascribed either to a tolerance or to the effect of the bicarbonate. Dogs inhaling an atmosphere containing 20 mg of uranium nitrate exhibited marked proteinuria, but only a slight and inconstant glycosuria. The blood NPN and urea nitrogen was uniformly elevated; these values decreased to normal in surviving dogs. The blood CO_2 fell with minima in the 4th and 8th days; thereafter rose again so that death did not occur in the periods of most marked acidosis. As to the carbohydrate metabolism, the fasting blood glucose was normal; however, as with rats, the tolerance curves were high, but the administration of bicarbonate did not influence this excessive and prolonged rise. The blood lactate and pyruvate which rises in the normal dog to a maximum 15 to 30 minutes after a dose of glucose showed no increase in uranium-poisoned dogs, or occasionally showed a small and late rise. In the recovery phase the surviving dogs returned to a normal glucose tolerance curve, together with normal lactate and pyruvate curves.

In summary, the effect of uranium-poisoning on carbohydrate metabolism may be described efficiency of utilization apparently related to the glycolytic formation of triosis. Injected glucose yields higher than normal body glucose values, normal liver glycogen values, erratic muscle glycogen values, and lower than normal blood triose values.

When rats inhale an atmosphere containing 29 ppm of HF for 2 days (this concentration is lethal in 26 days), tolerance studies show a high body glucose initially which becomes normal in 4 hours, liver glycogen values are normal, muscle glycogen formation is depressed.

When dogs inhale the same concentration (29 ppm) of HF for 2 weeks, no changes in carbohydrate metabolism following glucose administration were observed (this concentration of HF is not lethal to dogs in one month).

Rats were poisoned with alloxan which produces a necrosis of the islet cells of the pancreas. Doses of 0.2 g/kg killed 43 per cent of the rats and produced anurea or glycosuria or aciduria in the survivors. There were many examples of fatty livers.

Following the administration of glucose the body glucose was very high, with a maximum at 4 hours. The muscle glycogen values were low in the non-fasted animals, increased with fasting, and decreased again with glucose administration. An important difference between the uranium-or fluoride-poisoned animals and the alloxan-poisoned animals lay in the liver glycogen changes. After alloxan there was practically no liver glycogen in the non-fasted or fasted animals and only slight amounts of liver glycogen appeared after glucose administration. If the alloxan-treated animals are regarded as diabetic, it is plain that the uranium- or fluoride-poisoned animals should not be described as diabetic since in such animals liver glycogen formation was normal.

*AECD - 1921 Chromosomal Rearrangements Induced in Tradescantia by Fast Neutrons from Uranium Fission, by N. H. Giles, Jr. and A. D. Conger, 1 p., n.d., decl. 3/25/48.

For oral presentation at the Eighth International Congress of Genetics in Stockholm, Sweden, July 7 - 14, 1948, and to be published in Proceedings of the Congress.

This document is an abstract and is presented here in its entirety.

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The effects of fast neutrons from uranium fission in the Oak Ridge Pile in producing chromosomal rearrangements in the microspores of Tradescantia have been studied. Inflorescences were exposed to fission neutrons in a device designed to insure the maximum possible exclusion of slow neutrons and gamma radiation during treatment. Fast neutron doses were measured with a 100 r Victoreen thimble ionization chamber. Acetocarmine smear preparations of the microspore mitosis, made on the fourth or fifth day following treatment, were analyzed cytologically. As in previous experiments with cyclotron neutrons, the frequency of both translocations (dicentric and centric ring chromosomes) and deletions (acentric ring chromosomes) increases linearly with dose, indicating that these rearrangements are one-hit types, both breaks being produced by a single recoil proton. However, the efficiency of fission neutrons in producing translocations is found to be greater than that of cyclotron neutrons. In experiments in which comparative doses were measured with the same dosimeter, Yale cyclotron neutrons (maximum energy ca 7.5 Mev; average energy ca 4 Mev) are found to be about one-half as efficient as the fission neutrons produced in the exposure device utilized in these experiments (average energy less than one-half that of the Yale cyclotron neutrons). These results are in agreement with these obtained in previous comparisons of cyclotron neutrons of different energies. They are interpreted as indicating that as fast neutron energy decreases, efficiency of producing chromosome breaks increases due to the greater average ionization density along the paths of the resulting recoil protons.

AECD - 1922 The Distribution of Radioactivity in the Mouse Following Administration of Dibenzanthracene Labeled in the 9 and 10 Positions with Carbon Fourteen, by C. Heidelberger and H. B. Jones, 23 p., January 30, 1948. (UCRL-43).

For publication in Cancer.

Dibenzanthracene, labeled in the 9 and 10 positions with carbon 14, has been administered to mice intravenously and by stomach tube as an aqueous colloid, and intraperitoneally subcutaneously, and by stomach tube in tricaprylin solution.

The distribution of radioactivity in the mice at various time intervals after administration of the carcinogen has been determined.

The radioactivity is rapidly eliminated, largely through the feces, and ordinarily very little is absorbed. The distribution and rate of elimination depends upon the mode of administration.

There is an appreciable quantity of radioactivity in tumors produced several months after a single subcutaneous injection of dibenzanthracene.

There appear to be no detectable effects from the radiation of the labeled carcinogen.

AECD - 1923 The Metabolic Degradation in the Mouse of Dibenzanthracene Labeled in the 9 and 10 Positions with Carbon 14, by C. Heidelberger, M. R. Kirk, and M. S. Perkins, 25 p., January 30, 1948. (UCRL-45).

For publication in Cancer.

Evidence is presented which proves that dibenzanthracene is metabolized by the mouse into at least four substances, and some speculations as to the sites of this degradation are advanced. It is possible

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that a small amount of these compounds is produced as an artifact from dihydroxydibenzanthracene during the isolation procedure.

The fact that unchanged dibenzanthracene is found in tumors six to eight months after their induction is an interesting one, and has previously been demonstrated spectrophotometrically by Lorenz and Shear. This observation does not throw any light on the problem as to whether the original hydrocarbon is the true carcinogen, or whether some metabolite is. In view of the increasing body of evidence that only very minute quantities of carcinogenic hydrocarbons are required to initiate the irreversible process that leads to the tumor, the fact that appreciable amounts of dibenzanthracene are found in the tumor is of little more than academic interest. It seems likely that the metabolic degradation described is merely a detoxication process quite unrelated to the initiation of cancer.

This work is being continued with the aim of elucidation of the structures of these metabolites, and the various fractions described are being tested both for carcinogenic and tumor-regressive properties.

AECD - 1924 Studies on Blood Histamine. Partition of Blood Histamine before and after Clotting in Health and Disease States, by W. N. Valentine and J. S. Lawrence, 16 p., March 1948. (UR-14).

For publication in the American Journal of Medical Science.

Blood histamine studies have been made on blood obtained from patients with a variety of disease states as well as from normal individuals. In all subjects studied the blood histamine values were within essentially normal limits (0.10 gamma histamine base per cubic centimeter of blood or less) except those patients with myeloid leukemia in which values of tremendous magnitude were often found. The studies confirm the fact that the majority of blood histamine is contained within the granular leukocyte series. No close correlation between the absolute number of granulocytes or the differential counts and the blood histamine levels of different individuals can be made, however.

When blood from normal subjects or subjects with myeloid leukemia is allowed to clot there is no appreciable liberation of histamine from cells to serum as some observers have previously reported. After clotting the majority of blood histamine is still contained within the myeloid leukocytes.

AECD - 1925 A Hematological and Histological Study of the Bone Marrow and Peripheral Blood of the Adult Dog, by P. E. Rekers and M. Coulter, 42 p., February 1948. (UR-9).

For publication in the American Journal of Medical Science.

The bone marrow of ribs, femora, tibiae, and humeri and the peripheral blood of adult normal dogs of both sexes between 9 to 24 months of age, have been studied and the findings tabulated.

Cellular distribution was shown to be fairly uniform throughout the marrow bearing areas of the dog whereas the cellularity underwent wide variations.

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Methods for examination of the bone marrow of the dog are described.

A significant alteration in degree of cellularity and cellular detail was not found in the bone marrow within the first eight hours after death.

*AECD - 1926 Meson Mass Estimation by Grain Counting in Photographic Emulsions, by W. H. Barkas, E. Gardner, and C. M. G. Lattes, 1 p., April 19, 1948, decl. 5/10/48. (UCRL-86).

For oral presentation before a meeting of the American Physical Society to be held in Pasadena in June 1948, and for publication in the Bulletin of the American Physical Society.

This document is an abstract and is reproduced here in full.

Negative mesons produced by the 184-inch Berkeley cyclotron have been studied by means of Ilford C.2 photographic plates of emulsion thickness 50 μ. The meson tracks lie approximately parallel to the plane of the emulsion, and often end in the emulsion. The track grains are about 0.35 μ in diameter. For particles carrying one unit of charge, the number of grains, N(R), in a residual range R is assumed to be given by $N(R) = M f(R/M)$, where M is the mass of the particle. By counting grains in meson tracks and proton tracks, found in the same plate, the mass ratio of meson to proton can be found. A consistent convention for estimating the number of grains which occur in clumps reduces subjective errors. Comparisons of masses obtained by grain counting and by magnetic deflection on the same particle are made. Results of different observers are also related. Masses of star producing and non-star producing mesons are compared.

AECD - 1927 Four-Way Stopcock, by K. S. Bergstresser, 2 p., n.d., decl. 4/23/48. (LADC-509).

For publication in Analytical Chemistry. This also declassifies the four-way stopcock.

For certain purposes a four-way stopcock can be made with little difficulty from an oblique bore three-way stopcock which has a hollow plug. The need for a four-way stopcock arose when it was necessary to quickly evacuate one flask while allowing air to return to another previously evacuated flask. It was also desirable to have the air return to the first evacuated flask along the same path used for removing the air. To permit such a combination of operations by turning a single stopcock through a 180° angle, a three-way stopcock with oblique angle bore was modified.

*AECD - 1928 The Detection of Positive Mesons Produced by the 184" Cyclotron, by A. S. Bishop, J. Burfening, E. Gardner, and C. M. G. Lattes, 1 p., April 19, 1948, decl. 5/10/48. (UCRL-85).

For oral presentation before a meeting of the American Physical Society to be held in Pasadena in June 1948, and for publication in the Bulletin of the American Physical Society.

This document is an abstract and is presented here in full.

Positive mesons have been produced by the 184" cyclotron and detected with photographic plates. The method of production is similar to that used for negative mesons. (AECD - 1846).

Two methods of exposure to positive mesons are available: (1) Plates are placed below the circulating beam at a smaller radius than that of the target. Positive mesons emitted from the target with the

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proper energy in a forward direction are 180° focussed upon the plates. (2) Plates are placed in the position initially used for exposure to negative mesons, but the shielding is modified to admit those positive mesons which are emitted from the target in the backward direction. Plates exposed in this way thus contain positive meson tracks which start at one edge and negative meson tracks which start at the opposite edge.

In about half of the cases tracks of positive secondary mesons are observed to originate from the above-mentioned positive primary mesons. It is believed that all of the primary positive mesons decay into secondary mesons, but that in some cases the secondary meson is not seen because of unfavorable angle or bad background of neutron knock-ons, or both.

* AECD - 1929 Radioactive Products of High Energy Deuteron Bombardment of Cu, by D. Bockhop, A. C. Helmholz, and J. M. Peterson, 1 p., April 19, 1948. decl. 5/10/48. (UCRL-88).

For oral presentation before a meeting of the American Physical Society to be held in Pasadena in June 1948, and for publication in the Bulletin of the American Physical Society.

This document is an abstract and is presented here in full.

Serber has suggested inelastic collisions in which only a fraction of the available energy is lost as the initial step in the formation of nuclei by high energy particle bombardment. The nucleus thus excited subsequently boils off particles and energy. This theory differs from that of the compound nucleus, which holds at low energies, in that the incident particle is not captured. Serber's theory has been applied with success to several cases. The characteristic feature of the excitation function is the large value of cross section at high energies (~ 5 times the threshold) relative to that predicted by the theory of the compound nucleus. The formation of atomic number Z + 1 from target of atomic number Z cannot proceed by this process since it requires the capture of a proton although another possibility would be an exchange collision between incident proton and a neutron.

The excitation functions of a number of radioactive species from the bombardment of Cu with 190 Mev deuterons have been measured. Chemical separation of a number of fractions including Zn, Cu, Co, and Ni were performed. The Zn^{63} and Zn^{62} activities which must be formed as mentioned above show maxima at less than 50 Mev, and steady decreases to the highest energy measured (140 Mev) where the values are less than 1/5 those of the maxima. This is in accord with considerations of the compound nucleus. However, Ni and Co activities show maxima at low energies, minima and subsequent increases at higher energies, such as are characteristic of Serber's theory.

AECD - 1930 The Chemistry of Americium Compounds, by S. Fried, 17 p., March 24, 1947, decl. 4/15/48. (CC-3786).

For oral presentation at the April 1948 Symposium of the American Chemical Society, and for possible publication in a technical journal.

An abstract of this document has previously been issued as MDDC - 1753 and listed in this journal.

AECD - 1931 Production of Mesons by the 184-Inch Berkeley Cyclotron. Part I. Experimental Arrangement, by E. Gardner and C. M. G. Lattes, 11 p., n.d., decl. 5/5/48. (UCRL-80).

For oral presentation before a meeting of the American Physical Society held in Washington, D. C., April 29 - May 1, 1948, and for possible publication in a technical journal.

See AECD - 1846.

Tracks have been observed, which are believed to be due to mesons, in photographic plates placed near a target bombarded by 380 Mev alpha particles. The plates used were Ilford Nuclear Research Plates, type C.2. The identification of the particles responsible for the tracks was first made on the basis of the appearance of the tracks; they show the same type of scattering and variation of grain density with residual range found in cosmic ray meson tracks by Lattes, Occhialini, and Powell, and about two-thirds of them produce observable stars at the end of their range. For a 10-minute exposure in the cyclotron, about 50 meson tracks are found along the 3-inch edge of a photographic plate. Carbon, beryllium, copper, and uranium have been used so far as target materials, and all are found to give mesons. When a carbon target was bombarded with 300 Mev alpha particles, mesons were found but with reduced yield.

AECD - 1932 Stopping of Fission Fragments, by W. M. Good, E. O. Wollan, and W. A. Strauser, 14 p., n.d., decl. 4/30/48.

For oral presentation before a meeting of the America Physical Society held in Washington, D. C., April 29 - May 1, 1948, and for possible publication in a technical journal.

An abstract of this document has previously been issued as MDDC - 1793 and listed in this journal.

AECD - 1933 Isolation of Actinium (Ac^{227}), by F. Hagemann, 9 p., February 1948, decl. 4/15/48. (ANL-JJK-14B-120).

For oral presentation at the April 1948 Symposium of the American Chemical Society and for publication in a technical journal.

An abstract of this document has previously been issued as MDDC - 1738 and listed in this journal.

AECD - 1934 Assignment of 48 Min and 2 Min Isomers of Cd, by A. C. Helmholz and C. L. McGinnis, 1 p., April 19, 1948, decl. 5/10/48. (UCRL-87).

For oral presentation before a meeting of the American Physical Society to be held in Pasadena in June 1948, and for publication in the Bulletin of the American Physical Society.

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This report is an abstract and is presented here in full.

The assignment of the 48 minute isomerism to Cd^{111} by Goldhaber has been verified by bombardment of enriched isotopes with fast neutrons. The activity has also been produced by high energy alphas (> 20 Mev) on Ag(Ag(α,pn)), and Pd^{108} (α,n). Attempts to separate this activity from the 2.7d In^{111} have failed, showing that the two γ-rays of energy 173 and 247 kev observed in its decay are not the same as the two of energy 145 and 230 kev reported in the 48 minute isomerism by Hole. Further work on these γ-rays will be reported.

The 2 minute isomerism in Cd has been assigned to Cd^{113} also by bombardment of separated isotopes with fast neutrons. Initial measurements have given 2.3 min. as the half-life.

AECD - 1935 Operating Instructions for the Gamma-Beta Ray Survey Meter, by O. G. Landsverk, 9 p., October 13, 1944, decl. 5/5/48. (MUC-WPJ-106).

Disposition as required for use in research, development, or manufacturing work. This also includes declassification of the gamma-beta ray survey meter.

The gamma-beta ray survey meter is a portable electrometer instrument suitable for measuring gamma and beta radiations.

Instructions are given for operation as a survey meter and also as a laboratory meter. In addition, directions are given for servicing the instrument.

A circuit diagram is included.

AECD - 1936 Production of Mesons by the 184-Inch Berkeley Cyclotron. Part II. Mass Determination, by C. M. G. Lattes and E. Gardner, 5 p., n.d., decl. 5/5/48. (UCRL-81).

For oral presentation before a meeting of the American Physical Society held in Washington, D. C., April 29 - May 1, 1948, and for possible publication in a technical journal.

See AECD - 1846.

The mass of the mesons produced by the 184-inch Berkeley cyclotron has been determined by measuring the bending in the magnetic field and the range in emulsion. The radius of curvature of the trajectory is found by measuring the distance from the target to the point at which the meson enters the emulsion and the angle which the track makes with the edge of the plate. From the first 50 meson tracks measured a mass of 313 $\pm$ 16 electron masses was found. It is highly probable that these mesons are the heavy mesons described by Lattes, Occhialini, and Powell. The mass determination which was made was done with apparatus intended only for survey work, and some of the error is associated with lack of precision of location of the photographic plates. There was an aluminum foil of thickness 0.001 inch in front of the plates. It is thought that much better accuracy will be possible with better apparatus and a thinner foil.

*AECD - 1937 Thermal Neutron Flux in the Clinton Nuclear Reactor, by R. T. Overman, 1 p., n.d., decl. 5/7/48.

Disposition as required for use in research, development, or manufacturing work.

The entire document is reproduced here.

This pile is normally operated at a power of 2000 kw. For experimental reasons, there are sometimes very considerable departures from this value.

The thermal neutron flux in the reactor is definitely dependent upon what materials are in the pile. As a general rule, however, this flux is approximately 10^{12} neutrons/cm^2/second. Experimental radiations are usually carried out at a flux of $5 \times 10^{11} \pm 50\%$ neutrons/cm^2/second.

AECD - 1938 Crystal Structure Determination from Rough Intensity Relations, by J. S. Lukesh, 22 p., n.d., decl. 5/6/48.

For publication in Acta Crystallographica.

A method has been described by means of which probable atomic positions in crystals can be obtained rapidly and easily.

The method is based on an idea commonly used by structure investigators. If a given pinacoid "reflection", 300 for instance, is very strong and -- especially, though not necessarily -- if succeeding orders of this reflection decrease in intensity in an orderly manner, one feels reasonably certain that there are accumulations of scattering matter at x = 0, 1/3, 2/3. This information forms a starting point in the construction of a trial structure.

The information obtained should proved useful in the selection of a logical structure for computation of structure amplitudes. In some cases, as in the example presented, the actual structure can be obtained uniquely. In general, this will not be so and many possibilities will exist. The use of Patterson vectors will help the selection. Results will probably be poor when there are many atoms of nearly the same scattering power and when there is no great variation in intensities. Accuracy cannot, of course, be obtained by use of the method, nor can low scattering atoms be located. It is believed that the method may be useful, under proper conditions, in guiding the preliminary steps of structure determination.

* AECD - 1939 Neutron Spectra from Proton Recoils in Photographic Emulsions, by F. Reines, 1 p., n.d., decl. 5/10/48. (LADC - 518).

For oral presentation at a meeting of the American Physical Society.

This paper is an abstract and the entire text is presented here.

With the coming of nuclear reactors, it becomes interesting to determine neutron spectra for isotropic neutron fluxes.

The proton recoil technique rising photographic emulsions may be adapted to this case. Criteria, based on geometrical probability are provided for the treatment of all tracks which do not touch an

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emulsion boundary. Emulsion shrinkage is considered. The range energy relation for protons in photographic emulsion is applied to the tracks to yield the neutron spectrum which is related to the proton recoil spectrum by the equation:

$$n(E) = C \quad \lambda(E)\, E^{1/2}\, \frac{d\, m\,(E)}{dE}$$

where C is a constant, $\lambda(E)$ is the mean free path for neutron proton collisions in the emulsion at neutron energy E, m(E) represents the recoil proton spectrum and n(E) is the desired neutron spectrum. This equation is valid when $\lambda(E)$ is large compared with the dimensions of the photographic plate employed. Work is progressing on a method which considers all tracks independently of whether they penetrate the emulsion.

*AECD - 1940 Analogies between Gaseous Diffusion and Fractional Distillation, by J. Shacter and G. A. Garrett, 19 p., April 7, 1948, decl. 5/7/48. (K-197).

For oral presentation before a meeting of the Knoxville - Oak Ridge Section of the American Institute of Chemical Engineers and to be submitted for publication in a technical journal.

The principles of both distillation and diffusion (or more properly effusion) can be utilized in fractionation processes which take advantage of a difference in behavior between two or more components of a mixture to cause a difference in composition between two flow fractions. This effect is then multiplied: these different fractions are transported in opposite directions, and the countercurrent flows are repeatedly combined and separated until the desired concentration range has been spanned.

It is shown that the mathematical treatment of a gaseous diffusion cascade where all stages are identical is equivalent to the treatment of a fractional distillation column. The stage separation factor is analogous to the relative volatility in fractional distillation.

Steady-state equations are derived which apply to the general topic of fractionation. Some concepts relating to idealized and practical systems are discussed.

*AECD - 1941 Multivibrator Quenching of Geiger-Mueller Tubes, by B. J. Thamer and A. F. Voigt, 1 p., n.d., decl. 5/10/48.

For publication in the Bulletin of the American Physical Society.

This document is an abstract and is presented here in full.

Lowering or reversing the sign of the potential on the anode of a Geiger-Mueller tube is an effective way of quenching the tube discharge and allowing the tube to regain its sensitivity rapidly, thus reducing the counting loss at high counting rates. An electronic circuit capable of applying a quenching pulse of any desired width and magnitude has been developed. The amplified G-M tube pulse actuates a multivibrator which triggers the quenching tube.

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A series of dead-time determinations was made on several G-M tubes using paired samples, keeping the width of the quenching pulse at 12 microseconds and varying its magnitude from 0 to a value sufficient to make the center wire 50 volts negative with respect to the cathode. Quenching pulses in the range from 0 to 400 volts gave dead-times of roughly 200 microseconds. Important factors were the previous history of the tube and its operating potential. When the quenching pulse brought the wire potential within ±50 volts of the cathode, the dead-times were approximately 40 microseconds.

* AECD - 1942 Studies on the Radiation of Hf^{181}, by A. F. Voigt and B. J. Thamer, 1 p., n.d., decl. 5/10/48.

For publication in the Bulletin of the American Physical Society.

This paper is an abstract and the entire text is reproduced here.

Absorption and coincidence absorption measurements have been made on the radiation from 46 day Hf^{181}, obtained by pile thermal neutron bombardment. The energy of the principal gamma radiation was found to be 0.52 ± 0.05 Mev while that of the beta radiation was 0.63 ± .03 Mev by Feather analysis. Measurement with a magnetic field showed only negative electrons.

The coincidence study showed a conversion electron of 0.12 Mev energy in coincidence with the beta ray. Beta spectrometer studies have shown a 0.12 Mev electron to be an L conversion electron of a 0.132 Mev gamma ray which electron is probably the one observed, the K electron being too soft (0.065 Mev) to be detected. However, deBenedetti has reported a 0.11 Mev electron to be emitted in a 22 microsecond delayed transition. Since the resolving time of the present circuit is 0.67 microsecond it is impossible that the delayed electron would give the observed coincidence rate. Without knowing whether both of these are L electrons the energies of the coincident and delayed transitions cannot be stated with certainty.

AECD - 1943 Neutron Density, Point Source and Plane Source, by B. Carlson, 10 p., March 11, 1948, decl. 5/5/48. (LADC - 506).

Disposition as required for use in research, development, or manufacturing work.

The functions $\epsilon(r)$ and $\epsilon(z)$ related to the non-asymptotic part of the density for a point source and a plane source respectively have been computed for r, z = 0(.1)1.0(.5)5.0(1.0)20.0, and for f = 0.0(.1)-1.0.

* AECD - 1944 Activities Produced by Bombardment of TiO_2 with Pile Neutrons, by R. E. Hein and A. F. Voigt, 1 p., n.d., decl. 5/10/48.

For publication in the Bulletin of the American Physical Society.

This document is an abstract and the entire text is presented here.

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The radioactive isotopes produced by epi-Cd neutron bombardment of titanium dioxide have been investigated using the Argonne heavy water pile. A chemical separation on the irradiated TiO_2 was effected for the purpose of identifying radioactive products from (n, γ), (n, 2n), (n, p) and (n, α) processes. The following activities were identified: Ti^{51}, Sc^{46}, Sc^{47}, and Ca^{45}. These identifications were based on observed beta ray energies and half-life measurements as well as chemical evidence. The cross sections for the formation of these activities from their appropriate titanium isotopes and an upper limit for Sc^{48} were estimated. Since no monitoring sample was present, the estimate for the cross sections was based on measured activities, radiation log and neutron flux. The cross sections based on the total flux of neutrons of all energies are: $Ti^{51}\sigma = 8 \times 10^{-28}$ cm^2, $Sc^{46}\sigma = 2.5 \times 10^{-31}$ cm^2, $Sc^{47}\sigma = 6.9 \times 10^{-30}$ cm^2, $Sc^{48}\sigma = 1.3 \times 10^{-31}$ cm^2 and $Ca^{45}\sigma = 3 \times 10^{-32}$ cm^2. The presence of a contaminant, Sb^{123}, with an estimated $\sigma = 8 \times 10^{-24}$ cm^2, hindered the investigation. It is of interest that the 83 hour Sc^{47} was produced by an n, p reaction while the 44 hour Sc^{48} which is reported as a product of such a bombardment was not observed.

AECD - 1945 Studies with the Ranger, by D. L. Hill, 94 p., April 14, 1947, decl. 5/7/48. (CP-3800).

To be included in the NNES(MPTS), and for publication in Physical Review.

The partition of energy among the particles emitted in nuclear reactions is an essential facet of nuclear physics. Methods used for the study of this energy partition have generally been laborious -- as with the cloud chamber or photographic emulsion -- and the resultant descriptions have been correspondingly sketchy.

In an effort to make these energy studies less painful and the resultant descriptions more complete, a device has been developed, referred to as the Ranger, which permits the automatic electrical counting of heavy ionizing particles of selected species and range. The resultant distributions in range for the particles observed may be converted directly into the distribution in energy for (a) the observed particles if the object of study is the energy distribution for a proton, an alpha, or some other atomic nucleus, or (b) the inciting particle for the nuclear reaction if the object of study is the energy distribution for a neutron or a photon.

The essential advantage of the Ranger over the pulse-height-analyzer, which is another device for automatic electrical counting of particles, is its ability to select and study one species of particle produced in a region even though this region may be filled by a high density flux of neutrons, gammas, or whatnot, as is characteristic of modern sources. A detailed description, photographs and circuit diagrams of the detecting equipment are given.

Some estimate of the power of the Ranger may be gathered from the accumulated results on several energy distributions, as given in the report. The energy distribution of neutrons from a radium-alpha-beryllium source containing 0.875 grams of radium was determined from 0.5 to 18 Mev by measuring the range distribution of protons ejected by the neutrons from thin films of paraffin.

Another application was the search for K^{40} thermal (n, p) reaction. One section of the report also discusses in detail the general application of the Ranger to many problems of contemporary interest.

*AECD - 1946 Fundamental Considerations in Vacuum Practice, by R. Loevinger, 74 p., n.d., decl. 5/12/48. (BP-43).

To be included in the NNES(MPTS).

This chapter presents those parts of the kinetic theory of gases which are needed in modern industrial and laboratory vacuum practice. For the most part these are presented without proof. It is assumed that the reader is already familiar with the elements of the kinetic theory, but not necessarily with vacuum practice. The special equations of vacuum practice are developed and discussed fully, whenever possible. References are not given for the standard results of kinetic theory, since these are found in any good kinetic theory book. Sources are given for all material of special interest in vacuum practice.

In the body of the chapter, all formulae are given either in the c.g.s. system, or in a metric lab system which has pressure in microns and volume in liters. At the present time other systems are not appropriate in a scientific publication.

AECD - 1947 Preparation of Low Activity Radio-Cobalt γ-Ray Sources, by E. W. Rylander, 4 p., March 10, 1948, decl. 5/10/48. (ANL-HDY-471).

Disposition as required for use in research, development, or manufacturing work.

Cobalt sources were originally made by sealing radioactive powder within brass containers. This method has been supplanted by one in which cobalt pellets, cut from 3/16 inch diameter rod, are used. To keep the irradiation time within reasonable limits, the thickness of the pellet is varied with the activity desired.

The two locations readily obtainable for the irradiation of cobalt pellets, in the heavy water reactor, are the goat hole and the thimble. The goat hole has a lower, however more constant, neutron density than found in the central thimble. The neutron flux of the thimble is dependent upon the materials being irradiated in it. Therefore, when preparing a series of sources of desired activity, a weighed sample is irradiated, calibrated, and the μc Ra equiv/gm/KW hr is calculated; this constant is used to determine the irradiation times for subsequent bombardments.

Since the demand has been principally for counting standards, the conditions and procedure discussed applys to sources in the 50 to 1000μc Radium equivalent range.

*AECD - 1948 Phase of Scattering of Thermal Neutrons by Titanium, by S. S. Sidhu, L. Winsberg, and D. Meneghetti, 1 p., March 22, 1948, decl. 5/10/48. (ANL-HDY-467).

For publication as a Letter to the Editor of Physical Review.

This document is an abstract and is presented here in full.

Scattering of X-rays by the orbital electrons is always in the same phase as of the incident wave. Scattering of neutrons by the nuclei, however, has been shown to be either in the same phase or in the opposite phase. Of the elements previously investigated three elements H, Li, and Mn have been found to scatter in the opposite phase. It is reported here that titanium too scatters in the opposite phase.

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The criterion used in establishing the neutron scattering phase of titanium was the same as for the other elements. Each element is contained in a compound which has a NaCl type of structure, i.e., NaH, LiF, MnO and TiC. Except for NaH X-ray diffraction patterns of these compounds show that the reflections from even Miller indices atomic planes such as (200), (220), (222), etc., give strong intensities, and those from odd Miller indices planes such as (111), (113), (133), etc., give weak intensities. In the neutron diffraction patterns of these compounds the intensities are reversed.

Results were determined from a neutron diffraction pattern of TiC obtained with the Rotating Shutter Mechanism. They were confirmed with the neutron crystal spectrometer at the Oak Ridge National Laboratory.

AECD - 1949 The Production of Thin Be Foils, by H. Bradner, 6 p., March 18, 1948, decl. 5/10/48. (UCRL-38).

For publication in Review of Scientific Instruments.

The problem of making thin Be foils was presented in connection with focussing the proton beam in the Berkeley Linear Accelerator, and although the foils are not now used in the accelerator, they have proved to be quite useful as thin targets, target supports, thin windows, etc.

A procedure for making Be foils between 10^{-5} cm and 10^{-3} cm thick, and with diameters up to an inch and a half is described, and methods of mounting these foils are indicated.

The Be was evaporated in vacuum and deposited on a metal collector plate. The problems encountered were: (1) obtaining reproducible quantities of evaporated Be; (2) stripping of Be from the collector plate; (3) preventing curl of the foils when they were stripped; and (4) mounting the foils.

*AECD - 1950 The Decay Scheme of 47 hr Sm^{153}, by S. B. Burson and C. O. Muehlhause, 1 p., March 26, 1948, decl. 5/10/48. (ANL-HDY-474).

For oral presentation before a meeting of the American Physical Society to be held in Wisconsin in June 1948, and for publication in the Bulletin of the American Physical Society.

This document is an abstract and is reproduced here in full.

As seen by an argon filled mica end window counter the 47 hr period in Sm^{153} has been shown to have the following radiations:

.78 Mev β^-	~100%
Eu L X-rays	~ .25%
Eu K X-rays	~ .12%
110 Kev γ-rays	~ .03%
610 Kev γ-rays	~ .003%

By coincidence measurements using two mica end window counters the existence of these radiations were shown as follows:

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β^-, e^- (e^- ~ L conversion of γ_{110})	~ 90%
β^-, x (K and L-rays)	~ 7%
β^-, γ_{110}	~ 2%
x, x (K X-rays)	~ .85%
x, γ_{110} (K X-rays)	~ .15%

No delayed coincidences > 1.5 μs were found. It is therefore concluded that the existence of an almost totally converted level in Eu^{153} of energy < 100 Kev which is in cascade with γ_{110}, and (2) that the weak γ_{610} must follow a weak β^- branch of ~ 200 Kev from the 47 hr state in Sm.

* AECD - 1951 Neutron Bombarded Germanium Semiconductors, by R. E. Davis, W. E. Johnson, K. Lark-Horovitz, and S. Siegel, 1 p., n.d., decl. 5/12/48.

For oral presentation before a meeting of the American Physical Society to be held in Madison, Wisconsin, June 1948, and for publication in the Bulletin of the American Physical Society.

This document is an abstract and the entire text is presented here.

It has been shown recently that in germanium-semiconductors bombarded by deuterons and alpha particles lattice defects are produced which act as acceptors, thus producing "hole" conduction (P-type)(as tested by direction of rectification, Hall effect and photoeffect). P and N type germanium samples with known electrical characteristics have been irradiated with neutrons in the Oak Ridge reactor; resistivities in N-type semiconductors increase under neutron irradiation until the donators are neutralized, and the resistance reaches a maximum; under continued irradiation the conductivity increases again. In P-type germanium the conductivity increases steadily with neutron irradiation and values 100-200 times the original conductivity have been reached. Whereas the deuteron induced lattice defects are healed by prolonged heat treatment at 400°C only part of the neutron induced defects are healed in a comparable time interval.

Experiments with commercial N-type germanium rectifiers indicate changes in the forward and backward direction in agreement with the conclusion that the N-type germanium has been converted to P-type. The effect seems more pronounced in Cd shielded samples.

AECD - 1952 Chemical Properties of Astatine. I, by G. L. Johnson, R. F. Leininger, and E. Segre, 17 p., n.d., decl. 5/10/48. (UCRL-71).

Disposition as required for use in research, development, or manufacturing work and for possible publication in a technical journal.

This work is a report on studies of the chemistry of astatine on a tracer scale using the various methods of tracer chemistry. A general discussion of preparation of materials and analytical methods is included. The properties of astatine and its solutions as they appear in work on a tracer scales are discussed. Migration experiments have shown that astatine, when ionized in solution, is negative. Electro chemical, solvent extraction, and carrying studies are presented.

In general (1) elemental astatine is extractable by organic solvents; (2) the -1 state may be prepared by powerful reducing agents; and (3) at least two positive oxidation states exist.

*AECD - 1953 "Cross-Over" Transitions in Gamma Ray Spectra, by V. Myers and A. Wattenberg, 1 p., March 25, 1948, decl. 5/10/48. (ANL-HDY-473).

For oral presentation before a meeting of the American Physical Society to be held in Wisconsin in June 1948, and for publication in the Bulletin of the American Physical Society.

This document is an abstract and is presented here in full.

The possibility was investigated of there being very weak high energy gamma rays in certain isotopes than are known at present. In some instances, these gamma rays may be "cross-over" transitions, i.e., transitions directly from the highest level to the ground state rather than a cascade process. The technique consisted of placing the radioisotope inside a beryllium or heavy water target, and a BF_3 pulse ion chamber was used to detect any photoneutrons emitted. 37 minute Cl^{38} and 60 day Sb^{124} produced photoneutrons in D_2O (2.18 Mev threshold) while 34 hour Br^{82} produced photoneutrons in Be (1.63 Mev threshold). It is not known whether the Cl^{38} gamma ray is a "cross-over" transition, or whether it is the "2.15" Mev gamma reported by Siegbahn and lying just at the limit for photodisintegration in heavy water.

AECD - 1954 High Efficiency Fast Neutron Counters, by W. M. Preston, 8 p., n.d., decl. 5/10/48. (MonP-387).

For publication in a technical journal.

Proportional counters for fast neutrons, working on proton recoils are described. To increase the efficiency, the hydrogenous material was in the solid form and consisted of a number of polythene films, 4.92 mg/cm^2 thick, perpendicular to the counter wire. The counters were filled with a mixture of A and CO_2 up to 2 1/2 atmospheres total pressure. The efficiency and the behavior of these counters are discussed in the text. They are shown to be instruments which can be used with advantage in particular cases, their efficiency for fast neutrons traveling parallel to the wire being of the order of 1%.

* AECD - 1955 Observations on Superlattices in Order-Disorder Alloys Using Neutron Diffraction, by C. G. Shull and S. Siegel, 1 p., n.d., decl. 4/29/48.

For oral presentation before a meeting of the American Physical Society to be held in Madison, Wisconsin, June 1948, and for publication in the Bulletin of the American Physical Society.

This document is an abstract and is reproduced here in full.

The presence of superlattices in the order-disorder alloys Cu_3Au and FeCo subsequent to various heat treatments has been investigated using the neutron diffraction technique. The neutrons emerge from the ORNL reactor and are monochromated by a (200) reflection from a NaCl crystal. After passing through the sample, consisting of filings of the alloy, in a cell chosen to give about 70% transmission, the diffracted beam is detected with a BF_3 counter. In the case of Cu_3Au, for which the neutron scattering cross-sections are 7 and 10 x 10^{-24} cm^2, respectively, no superlattice lines can be found with neutrons from samples known to be ordered by conventional X-ray evidence. In the case of FeCo superlattice lines indicating complete order are found in samples slowly cooled from 800°C, no order is found in the

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case of samples quenched from elevated temperatures, or severely cold worked. In the case of FeCo the neutron technique is successful because of the relatively large difference in nuclear scattering cross-section, 12 x 10^{-24} cm^2 for Fe, 1.5 x 10^{-24} cm^2 for Co, while X-ray methods are made difficult because of the nearly identical electronic scattering cross-section for X-rays of neighboring elements.

AECD - 1956 The Secondary Electron Multiplier as a Particle Counter: Enlargement of Entrance Aperture and Improvement in Particle Discrimination, by A. H. Snell and L. C. Miller, 6 p., n.d., decl. 5/10/48.

For publication in Review of Scientific Instruments.

A description is given of modifications in design of a secondary electron multiplier, which enable the use of a larger entrance aperture with only a small increase in the size of the multiplier.

Some data are given on the pulse height distributions obtained with the above multiplier when counting different types of radiation: 8 kev protons, Po alpha-particles, S^{35} beta-particles, and Co^{60} gamma-rays. A method is described by means of which the multiplier can be adjusted so as to increase selectively the fraction of large pulses in the distributions from some of these radiations.

AECD - 1957 The Spectrochemical Determination of Beryllium, by L. T. Steadman, 9 p., n.d., decl. 5/12/48. (UR-18).

For publication in the Journal of Industrial Hygiene, and will also be submitted by the Sub-Committee on the Spectrographic Analysis of Beryllium to the Medical Advisory Committee on Beryllium in Industry for circulation in certain industries.

A spectrochemical method is described for analyzing beryllium in source materials including ores, dusts, Be compounds, urines, and other biological materials. The Be may be separated by an alcohol-ether extraction procedure. An analytical measurement of the Be is made with the d.c. arc and a medium quartz spectrograph.

AECD - 1958 Talk and Slides on Remote Control Apparatus, by R. C. Goertz, 33 p., April 12, 1948, decl. 5/10/48. (ANL-HDY-483).

For oral presentation at the April 1948 symposium of the American Chemical Society and for possible publication in a technical journal.

In handling radioactive materials, there is always health tolerances that must be met. The type of particles emitted, their energy and the rate of disintegration all come in to determine what kind of protection the operator must have.

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For alpha particles, the main problem is contamination. The danger is mostly in getting the material where it should not be and where it might get into the body by some means. Dry boxes are quite useful for this kind of work.

Where beta and gamma rays are being emitted, shielding is generally necessary. Glass or lucite will generally stop betas but it takes mass to stop gamma rays and lead is often used because of its low comparative bulk.

Much of the remote control of chemical operations are done by using air pressure or section to transfer liquids from one container to another. Special glass apparatus is often built up for a particular experiment and may be discarded at the finish of the experiment because it cannot be completely decontaminated.

Most of the slides shown and discussed are of special mechanical apparatus that is used both for chemical and physical operations, but mostly for physical operations. Much of the equipment can be used for many different things as it stands or with small modifications or additions. Photographs of 17 slides are included.

AECD - 1959 Mass Assignments of Some Radioactive Isotopes of Pd and Ir, by W. Rall, 9 p., May 1946, decl. 5/11/48. (CP-3518).

For publication in Physical Review or a similar journal.

See also MDDC - 64.

Mass spectrographic mass assignments of some radioactive isotopes of Pd and Ir were made using a high frequency spark source and a 90° electrostatic, 180° magnetic, Dempster type double focussing mass spectrograph. Results obtained confirm previous tentative evidence and makes the assignment of mass 109 definite for the 13 hour Pd. Results also definitely locate the 60 day activity of Ir at mass 192 and 19 hour activity at mass 194. The 1.5 minute activity could not be handled by the same methods, but recent work done at the Argonne Laboratory is reported to indicate that the 19 hour activity does not grow out of the 1.5 minute activity.

AECD - 1960 Ideal Theory of the Mitotic Index and Its Application to Tissue Growth Measurements, by J. G. Hoffman, 19 p., n.d., decl. 4/26/48. (LADC-498).

For publication in Anatomical Record or Cancer Research.

A statistical analysis is made of the mitotic index for the case of increasing cell populations and stationary cell populations. In both general cases, the mitotic index depends on the ratio of the mitosis time to the number doubling time.

The statistics for incidence of menstruation in a stationary population of humans are given to show that the simple theory predicts the actual incidence.

Mitotic index data for epidermis as a case of a stationary cell population are discussed with a view toward pointing out the importance of the mitosis time in the interpretation of mitotic indices.

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Values of the mitosis time are computed from the available data on the mitotic index in experimental tumors which grow exponentially.

A bibliography of 22 references is appended.

AECD - 1961 Cytological and Genetical Effects of Combined Radiations, by A. Hollaender, 2 p., n.d., decl. 4/6/48.

For oral presentation at the Eighth International Congress of Genetics in Stockholm, Sweden, July 7-14, 1948, and for publication in proceedings of the Congress.

This paper is an abstract, and is presented here in its entirety.

The production of chromosome aberrations and mutations by X-rays and ultraviolet shows a definite quantitative pattern which is not easily disturbed by physiological conditions; although certain temperature changes and other conditions might produce slight modifications. It was thought that besides these obvious changes which radiation produces, there might be a certain weakening of the chromosome structure or the material surrounding the chromosome through the influence of radiation which could not be detected by the usual methods. Such changes were found with treatments which in themselves have no measurable effects. The tool which was used most frequently is infrared radiation with a maximum at 10,000 A isolated by means of filters. This radiation was given in very high intensity and experiments arranged so that the temperature of the exposed material was not raised more than 3 or 4 degrees. This infrared radiation by itself will not produce any measurable cytological or genetical effects. However, if combined with X-ray or ultraviolet, either given before or after, it will increase significantly the number of aberrations in Tradescantia and mutations in fungus spores. In regard to chromosome breaks, the effect is independent of the time given whether before or after X-radiation. Time intervals up to 40 hours will not reduce the effect and is not reproducible by simply heating the material (Swanson and Hollaender). In contrast to these findings, combined radiation (infrared and X-ray) will not increase the number of sex linked lethals produced by X-rays in Drosophila (Kaufmann and Gay).

It is most important to point out that the field of combined radiations in cytology and genetics is explored very little and it deserves more attention of the investigator.

AECD - 1962 Studies of Bone Metabolism with the Aid of Radioactive Strontium, by D. C. Jones and D. H. Copp, 26 p., January 16, 1948, decl. 4/22/48. (UCRL-60).

For possible publication in a technical journal.

The kinetics of skeletal uptake and urinary excretion of radio-strontium were studied during the critical first hour following intraperitoneal injection of a carrier-free dose. These experiments not only provided valuable data concerning the metabolism and fixation of this important fission product, but, because of the close similarity of strontium and calcium, also gave basic information on the process of calcification. Three groups of rats were compared: normal mature adults, young growing normal animals, and young rachitic rats. In all groups, the blood radioactive strontium rose to a maximum in 10-15 minutes, and then declined as the strontium continued to deposit in the skeleton or to be

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excreted in the urine. Muscle and skin strontium curves followed those of blood quite closely, suggesting a rapid equilibrium between their extracellular fluid and blood plasma.

In all groups there was a continuous uptake of strontium by the skeleton. In the adults, this was almost constant, suggesting uptake by absorption and exchange with the calcium of the bone mineral. In the young rats, both normal and rachitic, the very rapid initial rate of uptake of radio-strontium tapered off sharply with time, indicating that some of this radioelement was coming back from the bone into the blood stream. This suggested a rapid labile combination of strontium in these animals, which, since it also occurred in the rachitic group in which normal calcification is inhibited, probably associated with the protein osteoid matrix present in both. A hypothetical calcification mechanism was suggested by these findings.

Urinary excretion and renal clearance of strontium was constant in all three groups, but the clearance was almost ten times as great in the rachitic as in the normal young and adult rats. This would seem to indicate a direct effect of rickets on the renal mechanism of radio-strontium (and calcium) excretion.

* AECD - 1963 The Relation of Particle Size of Uranium Dioxide Dust to Toxicity Following Inhalation by Animals, by H. B. Wilson, 29 p., February 1948, decl. 3/12/48. (UR-6).

To be included in the NNES(MPTS).

The relation of particle size to toxicity of uranium dioxide dust following inhalation by animals has been determined in 2 parallel studies. In both studies, 16 rabbits and 24 rats were exposed to UO_2 dust at approximately 80 mg/m^3. In the first experiment, the mass median (M_g) particle size was 0.45 μ. In the second experiment at the same dust concentration, the UO_2 had a mass median particle size above 1 μ. The size fractions were prepared by sedimentation methods. The dusty atmospheres were produced by means of an aspirator feed that developed an aerosol from a water suspension of UO_2. Collection of Cascade Impactor samples each day permitted a close check on particle size variation. The filter paper dust sampler was used to determine concentration. Particles from the "fine" suspension were found to have a total surface area ten times that of the particles in the "coarse" suspension, the difference resulting largely from the difference in particle size.

In the rabbit, (a) proteinuria, (b) elevation of urinary amino acid N-creatinine ratio, and (c) elevation of blood NPN occurred in both experiments but was significantly greater at 0.45 μ particle size. Renal pathology in the rabbit was about the same in both studies. In the rat, however, slight but definite renal damage was observed in nearly all animals exposed to UO_2 of 0.45 μ size, whereas practically none was observed in rats exposed to the larger particle sizes. Appreciable lung damage occurred in rats from the 0.45 μ particles; none from the particles of M_g greater than 1 μ. Retention of UO_2 in the lung in both species was 2-5 fold greater at the smaller particle size than at the larger. Accumulation of UO_2 in the kidney and femur was only one thousandth that in the lung. Differences related to particle size were less clear cut here.

AECD - 1964 Phosphatases in the Cell Surface of Living Yeast Cells, by A. Rothstein and R. Meier, 27 p., January 1948, decl. 3/16/48. (UR-5).

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For publication in the Journal of Cellular Comparative Physiology, and to be included in the NNES(MPTS).

See also MDDC - 1522.

In connection with studies of inhibition of glucose metabolism by uranium, it was found that yeast cells hydrolyze adenosine triphosphate (ATP) added to the medium. The products of hydrolysis, inorganic phosphate, and adenylic acid and the residual ATP could be recovered quantitatively in the medium. When ATP containing radioactive phosphorus (P_{32}) was used, none of the P_{32} was found in the cells even though 90% of the labile phosphate of the ATP was hydrolyzed, indicating that the hydrolysis was not occurring inside the cell. Because no ATP-ase activity was ever found in the cell-free medium, it must be concluded that this enzyme is on the cell surface of the yeast.

A number of the characteristics of the enzyme were determined. The pH optimum was 3.4, the ATP concentration necessary for optimum rate of hydrolysis was 0.4×10^{-3} M. The Km (Michaelis constant) was 1.6×10^{-4} and Vm (maximum velocity) was 0.087 micromols/10min/mg of yeast. With an excess of substrate the hydrolysis was a first order reaction (rate proportional to enzyme concentration). The rate of hydrolysis decreased markedly with time, despite the presence of ample substrate. The decrease in rate was not due to enzyme inactivation, but was associated with inhibition by the products of hydrolysis.

Other phosphorylated compounds such as adenosine diphosphate, inorganic triphosphate, inorganic pyrophosphate, Na glycerophosphate and Na phenyl phosphate were also hydrolyzed by the yeast cells. Differences in pH activity curves for these different substrates, and competition experiments between pairs of substrates suggested that several enzymes might be involved.

It is interesting to note that in addition to the ATP-ase, ATP also seems to be present on the cell surface as indicated by studies of the mechanism of uranium inhibition of glucose metabolism.

*AECD - 1965 Studies of the Metabolism and Toxic Action of Injected Radium, by W. P. Norris and H. B. Evans, 28 p., June 1946, decl. 4/22/48. (CH-3852).

To be included in the NNES(MPTS).

The most important period in defining the fate of radium in the animal body is that closely following administration, providing the material is readily available to the body fluids. This period is demonstrated in rats by the rapid disappearance of radium from the blood after intravenous injection and by the rapid uptake of radium from the peritoneal cavity as indicated by blood concentration curves following intraperitoneal administration.

The excretion of intraperitoneally administered radium in rats and mice was very rapid and reached such a low value within 10 days that further excretion had a negligible function in determining the final retention. There exists a linear logarithmic dependence of per cent injected dose excreted per day (log E) on time (log T). More of the excreted radium was present in the feces than in the urine.

The retention of radium, administered intraperitoneally to rats, mice, and rabbits, increased concomitantly with dose level. There exists a linear logarithmic dependence of per cent retention (log R) on dose level (log I). Three possible explanations for this effect are offered.

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In rats and mice, intraperitoneally injected radium was found to cause calcification of some of the soft tissues. The effect was noted in high incidence in the aortas of both species. In rats, calcareous sites were also found in the pylorus, liver, peritoneal wall, the region of the upper mediastinum, and, occasionally, in the testicles. In mice, the only other observed site of calcification was on the trachea. Calcification of the soft tissues in rats was often accompanied by pathologic lesions throughout the abdomen and a high radium content in the viscera.

The evaluation of the weight data in rats and mice, in terms of the ratio, Q(I; t), of the injected to control animals shows simple quantitative relations between weight effects and amounts administered or retained. On an equivalent roentgen basis X-rays appear to be somewhat more effective in producing weight loss than radium.

Evidence is presented to show that there exists a linear dependence of mortality (log m) on retained microcuries of radium (log R).

AECD - 1966 **Transplantation of Bone Marrow into Dogs That Have Received Total Body Single Dose Radiation, by P. E. Rekers, 241 p., n.d., decl. 4/26/48. (UR-11).**

For publication in Blood.

The subject of transplantation of mammalian tissue to mammalian hosts has been critically reviewed and the various theories propounded.

Single dose total body radiation of 350 r delivered to dogs may be regarded as a dose lethal to 50% of the animals within 8 to 23 days following radiation. Animals surviving to the 25th day after radiation in all probability will recover.

Hematological changes of most of the peripheral blood elements and histopathological changes of the bone marrow can be detected readily within 2 days or less and reach a maximum depression within 7 to 14 days of radiation. Depression of the lymphocytes appears early and is marked while depression of the erythrocytes is late and mild.

Recovery from radiation may be detected from examination of the peripheral blood by the 21st day or slightly earlier and from examination of the bone marrow by the 28th day or possibly sooner.

Clinical signs of radiation intoxication and recovery therefrom parallel the hematological and pathological findings.

Histological examination of the bone marrow shows early degeneration of the more primitive cells of the marrow parenchyma with subsequent disappearance of all types of parenchymatous elements. So-called "reticulum proliferation" has been poorly demonstrated in this study.

A predilection for destruction of the myeloid over the erythroid elements in the bone marrow following radiation cannot be assessed at this time although the myeloid-erythroid ratio is reversed after radiation and returns to normal with the recovery of the animal.

Animals recovered from and sacrificed 60 days after radiation show regenerative or hyperplastic changes in the bone marrow and varying degrees of regenerative and/or degenerative changes in the spleen and lymph nodes. Degenerative changes in the testis persist.

Animals dying from radiation uniformly show widespread purpuric manifestation, destructive or degenerative changes of the hematopoietic system, and less frequently degenerative changes in the testis and sepsis.

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Normal marrow transplantation to intramedullary marrow sites is without appreciable benefit to the radiated host. Such procedures induce intramedullary bleeding with resultant organization and fibrosis, rather than stimulation of bone marrow growth.

Bone marrow transplantation results in death and replacement of the graft. The newly formed bone marrow probably arises from persisting portions of the original marrow rather than the transplanted marrow.

Normal marrow transplantation to normal or radiated spleen is without appreciable benefit. Residual deposits of the marrow fat only can be demonstrated.

Stimulated bone marrow transplanted intravenously results in multiple heterotopic bone spicules within the pulmonary veins of the lungs. The evidence suggests that concomitant with this type of marrow transplanting the mortality is 43% whereas the mortality of the control group is 67%. Likewise, the total white blood cell count, the absolute lymphocyte, and the reticulocyte values of the peripheral blood are increased slightly in the transplanted group of animals.

Surgical procedures induce an additional load upon the radiated host. However, these procedures do not appear to inhibit the formation of callus and subsequent bone growth.

An explanation for the inability to transplant bone marrow successfully was studied further. Such failure could not be adequately explained on the basis of lack of demand on the part of the recipient for bone marrow, homogenicity or selection of transplant site. The transplantation of bone marrow to such regions as the anterior chamber of the eye, the subcutaneous region of the ear, intramuscular regions, intraperitoneal sites and within the medulla of long bones was uniformly unsuccessful.

The belief that tissue sensitivity can be reduced and rendered more acceptable for transplantation by passing the tissue through tissue culture media or subjecting the donor and/or host to radiation is not supported by these studies.

Autologous or homologous marrow transplanted to extramedullary sites rapidly results in heterotopic bone formation.

Shielding experiments suggest a sparing action on the part of the protected marrow for the host and cytological studies lend further evidence in support of the belief that the effect of radiation on hematopoietic tissues is a direct one. Furthermore, such experiments indicate total destruction of the bone marrow parenchyma requires more than a single dosage of 2000 r.

Transplantation of selected autologous, homologous and heterologous hematopoietic embryonal tissues to radiated hosts showed no evidence of alteration of the radiation intoxication in these hosts nor conclusive evidence of successful transplantation of these tissues in the short period of time studied.

Transplantation of selected autologous, homologous and heterologous embryonal tissues to non-radiated hosts and examined at least 60 days after transplantation frequently showed proliferating cartilage, some osteogenesis and occasionally a suggestion of early marrow formation.

AECD - 1967 The Influence of Age on the Uptake of Radioactive Phosphate by the Skeleton, by J. F. Bonner, Jr., 40 p., n.d., decl. 4/26/48. (UR-15).

Available for use as a thesis, and for possible publication in a technical journal.

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To determine the influence of age on the uptake of radioactive phosphate by the skeleton tracer amounts of radioactive phosphate were administered to five groups of rats varying in age from 15 to 170 days. The uptake of labeled phosphate by three representative bone samples was determined: femora and humeri, vertebrae, and skull. The uptake of P^{32} was approximately five times as great for the youngest animals (15 days) as the oldest (170 days). The appearance of radiophosphorus in these bones did not correlate with the rate of growth of inorganic portion of the bone. These data confirm the exchange hypothesis recently suggested as the mechanism by which radiophosphate is transferred from plasma to bone. It appeared that radiophosphate ions of the plasma undergo an isionic exchange with non-isotopic phosphate ions in the surfaces of the mineral crystals of the bone resulting in the fixation of quantities of radiophosphate much too large to attribute to growth processes. Excretion of the radiophosphate was found to have an inverse relation to the bone activity. The highest excretion rate was observed with recently weaned rats.

AECD - 1968 Certain Characteristics of the Complex of Uranium with Cell Surface Groups of Yeast: The Relationship of These Groups to Glucose Metabolism, by A. Rothstein, A. Frenkel, and C. Larrabee, 21 p., n.d., decl. 4/28/48. (UR-17).

To be included in the NNES(MPTS), and for publication in the Journal of Cellular and Comparative Physiology or Archives of Biochemistry.

Uranyl nitrate in low concentrations inhibits the anaerobic consumption of glucose to a maximum of about 90%. About 10% of glucose consumption is not poisoned by U. The relationship between inhibition, the initial U concentration and the yeast concentration involves a family of S-shaped curves, one for each yeast concentration. As the yeast concentration is raised, a higher initial U concentration is required to attain a given inhibition. From the relationship between inhibition, initial U concentration and yeast concentration, certain predictions can be made on the basis of simple assumptions:

1. If it is assumed that U forms a dissociable complex with certain "groups" necessary for the metabolism of glucose, thereby reducing the available concentration of these "groups", then on the basis of the mass law, it can be predicted that at a fixed inhibition, the initial U concentration should be proportional to the yeast concentration with an intercept equal to the equilibrium concentration of free uranyl ion in the medium. Such is the case.

2. If it is further assumed that the percentage inhibition is equal to the percentage of the total cell "groups" complexed with U, then a prediction can be made concerning the relationship of U-uptake by the cells to the inhibition. The predicted values were found to check reasonably well with the experimentally determined U-uptake. It is implied in the above assumption that U competes with some substrate for an enzyme and that the rate of glucose consumption is proportional to the concentration of enzyme not complexed by U.

The reaction between U and the yeast cell "groups" (Y), involved in glucose metabolism is of the form $U + Y \rightleftharpoons UY$ and the dissociation constant is about 2.5×10^{-7}. There are about 4×10^{7}, active "groups" per cell. In addition to the U complex associated with inhibition, there are two other complexes formed which are not involved in glucose metabolism. One involves 0.5×10^{7} groups per cell, and a lower dissociation constant, and the other 2 to 2.5×10^{7} groups per cell, and a higher dissociation constant than that for the complex associated with inhibition.

* AECD - 1969 The Half-Lives of Aluminum^{25} and Aluminum^{26}, by H. Bradner and J. D. Gow, 1 p., April 23, 1948, decl. 5/19/48. (UCRL-94).

For publication in the Bulletin of the American Physical Society.

This paper is an abstract and is presented here in full.

The availability of separated isotopes of Mg makes it easy to determine the half life of Al^{25}, a member of the Wigner series which has long been suspected to have a half life of approximately 7 seconds, but which has not been confirmed because of the masking 7 second activity of Al^{26}.

Mg^{24}, Mg^{25}, and Mg^{26} (in the form of MgO) have been bombarded with protons from the Berkeley Linear Accelerator, with the following results:

Mg^{24} yields an activity of approximately 23 seconds half life, presumably due to Na^{21} from the reaction $Mg^{24}(p,\alpha)Na^{21}$.

The Mg^{25} yields an activity of approximately 8 seconds half life, which is assigned to the reaction $Mg^{25}(p,n)Al^{25}$.

The Mg^{26} yields an activity of approximately 6 seconds half life, assigned to Al^{26} according to a similar reaction.

It seems probable therefore that the 7 seconds half life normally given for Al^{26} is a mixture of these two activities.

AECD - 1970 Chapter on Atomic Power, by D. Cochran, 72 p., March 22, 1948, decl. 5/6/48.

For publication in Kent's Mechanical Engineers' Handbook.

This document is a chapter on atomic power to be included in the latest edition of Kent's Mechanical Engineers' Handbook. All the data presented are taken from previously published or declassified sources.

So far, the nuclear reactors which have been publicly described are for the conversion of fertile to fissionable material, the production of radioactive isotopes and for experimental purposes.

It has been announced that nuclear reactors to produce useful power are under development. The sections on power conversion systems and atomic power systems are written in anticipation of the successful completion of these developments.

AECD - 1971 Delayed Neutrons from U^{235} after Short Irradiation, by F. deHoffman, B. T. Feld, O. R. Frisch, and P. R. Stein, 29 p., April 6, 1945 decl. 5/17/48. (LADC-251).

For publication in Physical Review.

The decay curve of the delayed neutrons from U^{235} after an approximately 10 millisecond irradiation is measured for times from 0.2 second to 10 minutes. This curve is resolved into 5 periods and their relative intensities are determined. When the data are converted to the conventional case of infinite

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irradiation the decay curve may be presented on a relative basis by the following formula where t is in seconds:

$$N(t) = 0.076\, e^{-t/0.52} + 0.279\, e^{-t/2.5} + 0.297\, e^{-t/7.9} + 0.294\, e^{-t/32.4} + 0.054^{-t/79.9}$$

Indications of a 6 millisecond delayed neutron period are found. These 6 millisecond period neutrons seem to amount to only 2% of the delayed neutrons when irradiated to saturation.

AECD - 1972 A Radiation Dose Integrator of High Sensitivity, by G. Dessauer, K. E. Davis, and F. A. White, 8 p., September 13, 1945, decl. 5/12/48. (M-1772).

Disposition as required for use in research, development, or manufacturing work. This also includes declassification of the radiation dose integrator.

The radiation dose integrator described was designed and constructed to serve as a radiation monitoring unit of high sensitivity and wide application. It differs from the Victoreen integron in being up to 100,00 times as sensitive. and self-resetting.

By suitable adaptation of the specially designed ionization chamber, the unit can be calibrated to measure neutron and gamma radiation in the range from tolerance dose (at tolerance rate) to large doses (fluxes of hundreds of r units per hour).

In addition to this wide range of sensitivity the integrator has the following advantages: (1) a.c. operated, (2) high stability and reproducibility, (3) dual counting and resetting controls, (4) self recording, and (5) ease in mobility of ionization chamber and control units.

Two diagrams and five photographs are included.

AECD - 1973 Photographic Neutron Dosimetry II, by G. Dessauer and J. Rouvina, 10 p., March 28, 1945, decl. 5/12/48. (M-1656).

Disposition as required for use in research, development, or manufacturing work.

The present report consists of a detailed set of directions and calibration tables for the cadmium method, and a few remarks on a more sensitive method which is still in the process of development.

A careful check-up has shown that the optimum thickness of cadmium to be placed on either side of the film is 20 mils. The calibrations have been carried out in the standard brass badge which is in use at the sites serviced by Rochester.

It has been found that a greater contrast between gamma and neutron blackenings on the film can be obtained by replacing the cadmium foils by indium or rhodium foils. Calibration work for rhodium intensification of neutrons is in progress.

AECD - 1974 On the Isotopic Composition of Meteoritic and Terrestrial Gallium, by M. G. Inghram, D. C. Hess, Jr., H. S. Brown, and E. Goldberg, 4 p., April 8, 1948, decl. 5/18/48. (ANL-AJD-240).

For publication in Physical Review.

The abundances of the isotopes in a sample of gallium separated from a meteorite were found to be the same as in ordinary gallium within the experimental error. The ratio of the abundances of the isotope at mass 69 to the one at 71 was found to be 1.509 as compared with the normal 1.510.

*AECD - 1975 Volume I. Heavy Water Part C. Bibliography. Chapter II. Bibliography of Published Literature, compiled by A. H. Kimball, 586 p., June 30, 1946, decl. 5/19/48.

To be included in the NNES(MPTS).

This bibliography is divided into three sections; author, subject, and compound. The references in the author bibliography are arranged alphabetically. The papers by a given author or group of authors are arranged in chronological order in so far as ascertainable. Approximately 80 per cent of the listings were obtained from Chemical Abstracts (January 1932 through December 1945). Most of the remaining references were derived from a bibliography compiled by George M. Murphy directly from the published literature between 1932 and 1936. Names which are spelled in more than one way are cross indexed, as are also co-authors. Review papers are so described.

Code letters following each paper refer to that section in the subject bibliography under which the paper is listed. Papers on nuclear reactions are not included unless other data of interest are reported.

The compound and subject bibliographies when used together should present a comprehensive picture of the content of each paper listed in the author bibliography. This permits convenient cross referencing.

AECD - 1976 Products of High-Energy Deuteron and Helium Ion Bombardments of Copper, by D. R. Miller, R. C. Thompson, and B. B. Cunningham, 6 p., April 6, 1948, decl. 5/18/48. (UCRL-74).

For publication as a Letter to the Editor of Physical Review.

The identity and relative yields of about twenty of the radioisotopes produced by the bombardment of natural copper with 190 Mev deuterons and 380 Mev helium ions have been determined. Two previously unreported isotopes were detected: Zn^{62}, decaying by orbital electron capture with a 9.5-hour half-life, and Fe^{52}, decaying by positron emission with a 7.8-hour half-life.

AECD - 1977 A 9 Centimeter Trochotron, by G. W. Monk, G. W. Steele, and L. E. Burkhart, 9 p., November 11, 1947, decl. 5/11/48. (Y-49).

For publication in Physical Review. This also includes declassification of the 9 centimeter trochotron.

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A brief description is given of a small mass spectrometer in which the ion paths are prolate trochoids. Typical mass scans demonstrating the resolution are reproduced.

AECD - 1978 RC Ohmmeter, by H. G. Neil, 5 p., January 29, 1946, decl. 5/11/48. (D-4.480.6).

Disposition as required for use in research, development, or manufacturing work and for possible publication in a technical journal. This also includes declassification of the RC ohmmeter.

The "RC ohmmeter" is an instrument suitable for measuring resistors in the range of 10^{10} to 10^{12} ohms. A 300 $\mu\mu$fd condenser is discharged through the resistor in question and the time required for the voltage across the condenser to decrease to 1/e of its original value is measured. The resistance is calculated from R = C/t, where R is in ohms, C in farads, and t in seconds. The accuracy of this instrument (which uses a vacuum tube electrometer) is limited primarily by the accuracy of the timing method used. A circuit diagram and photograph are given.

*AECD - 1979 The Detection of Light and Heavy Mesotrons Outside the Tank of the 184" Cyclotron, by W. K. H. Panofsky, 1 p., April 20, 1948, decl. 5/18/48. (UCRL-90).

For publication in the Bulletin of the American Physical Society.

This document is an abstract, and the entire text is given here.

The mesotrons artificially produced in the 184" cyclotron have been brought out of the cyclotron tank by means of a specially designed magnetic channel which brings mesotrons of $H\rho$ = 132,000 gauss-cm $\pm$ 12% out of the field of 14,000 gauss at the target into a region of 4,000 gauss in a re-entrant chamber in the cyclotron wall. Both light and heavy mesotrons have been detected in this chamber. A measurement of the life-time of the heavy meson appears possible in this arrangement.

*AECD - 1980 Excitation Curves of $C^{12}(p,pn)C^{11}$ and $B^{11}(p,n)C^{11}$ up to 32 Mev, by R. Phillips and W. K. H. Panofsky, 1 p., April 20, 1948, decl. 5/19/48. (UCRL-89).

For publication in the Bulletin of the American Physical Society.

This document is an abstract and is reproduced here in full.

The excitation curves of $C^{12}(p,pn)C^{11}$ and $B^{11}(p,n)C^{11}$ have been obtained by the stacked foil technique using accurately molded boron carbide and polystyrene sheets. 32 Mev protons from the Linear Accelerator were used as the bombarding particle. Owing to the homogeneity of the linear accelerator beam, very accurate resolution near the threshold has been obtained. The shape of the curve will be discussed.

AECD - 1981 The Cell Surface of Yeast as the Site of Inhibition of Glucose Metabolism by Uranium, by A. Rothstein and C. Larrabee, 19 p., February 18, 1948, decl. 5/6/48. (UR-8).

To be included in the NNES(MPTS), and for publication in the Journal of Cellular and Comparative Physiology or Archives of Biochemistry.

Yeast cells suspended in a dilute solution of uranyl nitrate, rapidly take up uranium. A rapid phase of U-uptake, complete in less than two minutes is followed by a very slow uptake continuing for at least 3 hours. At the end of the rapid phase of U-uptake the concentration of U in the cells is at least 50 times that in the medium, suggesting that a highly undissociated complex of U is formed. The relationship between U-uptake and the U concentration of the medium resembles a titration curve. With low U concentrations, nearly all of the U is taken up, but as the U concentrations of the medium are raised, the U-uptake reaches a maximum value, which is independent of further increases in the U concentration of the medium. Such behavior is inconsistent with the concept of uranium diffusion into the cell.

Other data inconsistent with the concept of penetration of uranium into the cell include: (1) The maximal concentration of U-complexing groups as calculated from U-uptake, is less than 1/100th that of the calculated U-complexing capacity of the aqueous phase of the cytoplasm. (2) Inhibition of glucose metabolism by U can be reversed by adding to the medium 1/50th the concentration of inorganic phosphate already present in the cytoplasm.

It is suggested that the rapid phase of U-uptake is associated with the formation of a complex with groups on the cell surface. Possibly the slow continued phase of U-uptake is associated with penetration into the cell.

AECD - 1982 Studies on the Color Reaction of Beryllium with Alkanet Preparations, by A. L. Underwood and W. F. Neuman, 18 p., April 5, 1948, decl. 5/12/48. (UR-19).

For publication in Analytical Chemistry.

A colorimetric method for the determination of small amounts of beryllium has been developed, employing a compound isolated from alkanet root. The effects of pH, concentration of the reagant, time of standing, heating, and several common ions have been studied. The accuracy of the method is quite satisfactory; a standard error of about 2.5% was obtained with a large number of synthetic "unknowns" in the range of 0.96 to 11.6 micrograms of beryllium.

AECD - 1983 The Rate of Rise of Bubbles, by E. P. Wigner, 3 p., April 7, 1944, decl. 5/14/48. (CP-1691 [A-2422]).

For publication in a technical journal.

It has been observed that the bubbles rising in boiling water acquire, in the course of their rise, a definite size and velocity. Smaller bubbles tend to grow, larger bubbles to split up until an equilibrium condition is reached. On the basis of dimensional considerations, the following formulae are proposed for these quantities.

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$$V = 1.93\ (\sigma g/\rho)^{1/4} \approx 2(\sigma g/\rho)^{1/4}$$

$$D = 1.10\ (\sigma/g\rho)^{1/2} \approx \sqrt{\sigma/g\rho}$$

where V = velocity, D = diameter, ρ = difference of the densities of liquid and vapor; σ = surface tension, and g = 981 cm/sec^2 = the acceleration of gravity.

AECD - 1984 A Current Integrator, by H. T. Gittings, 7 p., March 24, 1948, decl. 5/19/48. (LADC-520).

For publication in the Review of Scientific Instruments. This also includes declassification of a current integrator.

A current integrator has been developed to measure the number of positive ions in the ion beam of an electrostatic accelerator. The ions are collected in a Faraday cage with a secondary-electron barrier.

A capacitor between the cage and ground will accumulate a positive charge which is the integral of the beam current and is proportional to the number of ions collected. An amplifier with its input across the capacitor is designed to operate a relay when the capacitor has accumulated a predetermined amount of charge. The relay contacts short the capacitor which drops out the relay and restarts the cycle. The relay contacts also operate a mechanical counter which is calibrated in microcoulombs per count.

The accuracy of integration is 0.2 per cent for currents from 0.005 microamperes to 10 microamperes.

A circuit diagram of the integrator is given.

*AECD - 1985 On Neutron-Proton Scattering Models, by L. Goldstein and D. W. Sweeney, 1 p., n.d., decl. 4/29/48. (LADC-514).

For oral presentation at a meeting of the American Physical Society.

This document is an abstract and is persented here in full.

Using semi-empirical square-well interaction forms of the "central force" type, differential and total n-p scattering cross-sections have been obtained for neutrons of absolute kinetic energy extending to 90 Mev, with a variety of well-radii. The total n-p cross-section data of the Minnesota group, up to 6 Mev neutron energy, when compared with the computed cross-sections seem to favor well radii smaller than the classical electron rádius. In the intermediate energy range, 10-25 Mev, data on differential cross-sections might help in choosing the most appropriate well-radius and the type of interaction representing best the data. Available total cross-section data in this range are insufficient for this purpose, on account of the relative insensitivity of total cross-sections to well ranges, at smaller radii and to types of force (ordinary, exchange or symmetrical). The Berkeley results at 90 Mev neutron kinetic energy, while excluding "ordinary" interaction, are incompatible with either "exchange" or symmetric" type of interactions for wells with radii from 1.5×10^{-13} cm upward. Empirical mixtures" of different types of interactions might lead through to a satisfactory representation of these data.

AECD - 1986 Studies on the Barium Citrate Complex in Ammonium Chloride by the Ion-Exchange Method, by J. Schubert and J. W. Richter, 10 p., n.d., decl. 5/19/48.

For publication in Science.

Recent studies have shown how ion-exchange reactions, in combination with radiotracers, can be used to measure the dissociation constants of complex ions(MDDC - 612 and MDDC - 958). The investigation of metallic-organic complexes by the ion-exchange method is of particular interest inasmuch as the remarkable separations of cations that have been obtained with ion-exchangers depend on the equilibria existing among the cations, the ammonium ions and the citrate ions. This report gives the results of measurements of (a) the dissociation constants of the barium citrate complex ion, (b) the effect of pH on the adsorption of Ba^{140} and La^{140} by a cation-exchanger in the presence of citric acid, and (c) the exchange constants for the reactions where Ba^{140} and La^{140} are adsorbed by the ammonium form of the cation-exchanger.

In acid solution (pH = $\sim$ 2), citric acid has no effect on the adsorption of divalent or trivalent cations by a cation-exchanger because the undissociated form has no appreciable complexing action and contributes nearly nothing to the effective cation concentration of the solution. Thus, concentrations of citric acid as high as 0.8 M were found to have no effect on the adsorption of Ba^{++} from salt solutions at a pH of 2. As the pH of its solution is increased, however, the citric acid dissociates into ions capable of complexing action.

*AECD - 1987 Plutonium Project Record, Volume XX. Introduction. Being a General Introduction to Reports of Activities in Medicine, Health Physics, and Biology, by R. S. Stone, 27 p., June 1946, decl. 5/24/48.

To be included in the NNES(MPTS);

The objectives of the Health Division of the Metallurgical Laboratory as stated by the Laboratory Director were: (1) Protection of the health of the workers on the project; (2) Protection of the public from any hazards arising from the operation of the project; and (3) A study of the peculiar hazards with the purpose of being able to better establish tolerance doses, to better predict what might happen in the future, to devise means of detecting damage to personnel and to discover methods of treating any person who might be damaged.

To attain these objectives the Health Division organized four sections each having its own problems: (1) A Medical Section, (2) a Health-Physics Section, (3) a Biological Section, and (4) a Military Section.

The Medical Section was concerned largely with problems directly connected with personnel. It was assigned not only the usual medical responsibilities but also the task of making special studies of the personnel to determine the slightest indication of damage due to radiations or to chemically toxic materials. Since there were no well established clinical tests for any of the possible early changes resulting from these hazards this section had to extend its work to the development of clinical tests for such damage as might be anticipated.

The Health-Physics Section was concerned mainly with detecting, measuring, and protecting against radiations and interpreting the results in terms of health hazards. It evolved from a group originally assigned, by the Engineering Division, the task of estimating the amount of shielding that would be needed.

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The Biological Research Section was formed with the definite aim of filling in by experiments with animals as many of the gaps as possible in our knowledge of the responses of biological materials to radiations, to radioactive materials, and to the special chemicals. Everyone concerned agreed that the plans for plutonium production plants must be made on calculations of hazards based on such knowledge as already existed, but that the biological assumptions involved should be checked by experimentation as rapidly as possible. The three particular objects to be attained were the establishment of tolerance doses, the development of methods of detecting damage to personnel as early as possible; and the discovery of means of treating personnel who might be overexposed.

The Military Section was of rather short life as a part of the Health Division. It was formed to consider means of detecting radiations in the field and of protecting against enemy use of such materials, and to consider possible advantages of using chain reacting piles for producing radioactive material rather than of plutonium. The thought of using this material was rapidly given up and the protection against its use by the Germans was taken over by the Army.

As time passed, the program of the Health Division enlarged due to several factors: first, the number of people that had to be taken care of gradually increased; second, the need for improved health instruments and for developing methods of health monitoring became more obvious, and the space and personnel to do the work were increased; and third, more opportunities for biological research became available as the various piles came into operation. From the beginning it had been realized that all of the necessary work could not be done at the University of Chicago without a very great expansion of facilities and personnel. Consequently, other institutions where workers and space were available were asked to aid in the program.

That the direct medical protective activities of the Health Division were a success, not only at the University of Chicago and the Clinton Laboratories, but also at the Hanford Engineer Works, and at those laboratories and industries associated with the Metallurgical Project, is attested to amply by the fact that no one lost his life due to any of the hazards peculiar to the project.

AECD - 1988 Chemical Research--Analytical. Report for Month Ending April 15, 1945, by J. I. Watters and M. S. Fred, 22 p., May 12, 1945, decl. 5/14/48. (CC-2771).

Informal disposition and as aid for personnel at Chalk River Laboratories.

Data are presented on the gases evolved during the detarring of the graphite crucible assembly used in the vacuum fusion method for the determination of oxygen. Below 2100°C the rate of gas evolution increases abruptly with an increase in temperature but above this point shows no such increase. The composition of the gas was determined as a function of temperature and the CO and hydrocarbon content found to increase as the temperature was raised.

Attempts to increase the accuracy of the copper spark method are described. Reproducibility for uranium determinations is about 3%. Densitometry over a large intensity range is more difficult than for other methods because of the rapid decrease in intensity during the exposure.

Several polarograph cells are described which have been used successfully with as little as 100 to 200 microliters of solution. An insert anode using agar plus KCl or K_2SO_4 is shown, and two cells,

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for 100-200 and 300-500, using the anode, are described. A small cell using a mercury pool anode is also shown.

Experimental data obtained in the polarography of uranyl solutions in sulfuric and hydrochloric acids are presented and discussed. It is indicated that in the three-step reduction to U(III) in dilute sulfuric acid the first step corresponds to more than a one electron change. The U(V) intermediate either disproportionates or is reduced to produce a second wave depending on the acid concentration. The sum of the first two waves is, however, a two electron change. The effect of acid concentration and maximum suppressor on the wave shape is shown, and the precautions to be observed in interpreting slope analysis pointed out. The height of the first wave in 1 N H_2SO_4 was found to be linear with concentration to within an average of 1.8% and can be used for analytical purposes.

*AECD - 1989 The Nuclear Chemical Synthesis of Element 43, by G. E. Boyd and E. E. Motta, 2 p., n.d., decl. 5/18/48.

For publication in the program of the American Chemical Society in connection with the June Symposium on Property and Thermodynamics of Inorganic Substances.

This paper is an abstract and is presented here in full.

The various nuclear chemical reactions which may be employed in the synthesis of element 43 become a subject of interest in view of the increasing probability that all of the isotopes of this element are radioactive and decay with half-lives of less that 10^8 years. Until recently, the problem of the characterization of these atomic species with respect to mass assignment, half-period and type and energy of radiations emitted has been one of formidable complexity.

This paper will report upon the very great clarification of these difficulties that has been effected during the past year by virtue of an experimental study in which a variety of nuclear disintegration techniques were employed. Slow neutrons from the chain reacting pile at the Oak Ridge National Laboratory, together with fast neutrons and energetic deuterons produced by the sixty-inch cyclotrons at the Radiation Laboratory at Berkeley, California, and at the Department of Terrestrial Magnetism of the Carnegie Institution in Washington, D. C., were employed to effect a variety of nuclear transmutations on the separated molybdenum isotopes produced by the electromagnetic separation process at Oak Ridge. In all, fourteen radioactive nuclides of element 43 were produced, four of which had not been observed previously.

In the presentation of this study an attempt will be made to illustrate the application of the principles of nuclear chemistry. Rules governing relative nuclear stability, the occurrence of nuclear isomerism, and yields in nuclear transmutation reactions, etc., will be exemplified.

An important key to the problem of the occurrence of element 43 in nature was found during the cyclotron irradiations. The existence of extremely small amounts of element 43 in nature must presently be regarded as a possibility since the ground state of the nucleus of mass 97 is now known to possess an extremely large half-life.

AECD - 1990 A Quantitative Study of the Reaction between Beryllium and Quinizarin, 2-Sulfonic Acid, by M. W. Cucci, W. F. Neuman, and B. J. Muiryan, 16 p., May 6, 1948, decl. 5/25/48. (UR-26).

For publication in Analytical Chemistry.

Quantitative studies of the reaction between beryllium and quinizarin have led to the development of a procedure for the microanalysis of beryllium in solutions free of interfering substances. The procedure permits the determination of from 1-20 microgram Be(20 ml volume) with a probable error of less than 5%.

AECD - 1991 Physical Properties of Heavy Water, by I. Kirshenbaum, 41 p., n.d., decl. 5/27/48.

Disposition as required for use in research, development, or manufacturing work.

A study has been made of the information on the physical properties of heavy water. The data were evaluated wherever possible and the results are summarized in the report. For convenience, a general Bibliography is also given.

The report contains data on the following: molecular weight; density; molecular volume and phase diagram; lattice constants; melting point; boiling point; critical data, vapor pressure; heats of transition; heat capacity, entropy, and other thermodynamic data; surface tension; viscosity; index of refraction; verdet constant; dielectric constant; dissociation; diamagnetic susceptibility; velocity of sound and compressibility; conductivity; and solubility, 66 references; bibliography.

*AECD - 1992 A Progress Report on Theoretical Considerations of the Heat Transfer Coefficient, by R. N. Lyon, 25 p., April 1, 1948, decl. 5/24/48.

Disposition as required for use in research, development, or manufacturing work and to be submitted to the Department of Chemical Engineering, University of Michigan, for use as the basis for a thesis.

Because of many requests for a written summary of the theoretical heat transfer considerations, an unclassified portion of the Quarterly Progress Report of the Technical Division at the Oak Ridge National Laboratories for the period ending March 15, 1948, ORNL 8, is presented.

Since this is a progress report, the work is incomplete. A final unclassified report on the work can be expected within the coming year.

The developments are found to parallel those of Martinelli, von Karman, and Boelter with somewhat different emphasis and a number of additional conclusions, in particular, a single simple equation involving only two dimensionless groups for the approximation of the heat transfer to liquid metals.

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A definition is first established for the heat transfer coefficient and then a rigorous equation is set up for it in the case where physical properties are unaffected by temperature and where heat flow through the wall surface is uniform around the tube and along its length. Later the possible effects of changes in physical properties along temperature gradients are considered. The development is carried out for the situation far enough from the entrance to have established the ultimate velocity and temperature profiles.

No consideration is given to the case where the fluid does not wet the wall, although experimental work with mercury at General Electric and elsewhere has indicated that this situation is important.

*AECD - 1993 An Introduction to the Toxicology of Uranium, by A. Tannenbaum, H. Silverstone, S. Schwartz, and E. S. G. Barron, 77 p., November 1946, decl. 4/9/48. (CH-3696).

To be included in the NNES(MPTS).

This section is a brief review of the work on the pharmacology and toxicology of uranium carried out, in the main, by members of the Metallurgical Laboratory. It is intended as a concise summary for the general reader.

The individual chapters are abstracted below.

*AECD - 1993-A Chapter I. Introduction and General Considerations, by A. Tannenbaum and H. Silverstone, 4 p., November 1946, decl. 4/9/48.

An investigation of the toxicology of uranium was initiated in September 1942 in response to a practical need for knowledge regarding the effects that might be produced in laboratory and plant workers (Plutonium Project) exposed to uranium and its compounds.

The toxicological investigations reported in this review were carried out at Michael Reese Hospital, Chicago, under a subcontract with the Metallurgical Laboratory of the University of Chicago, except for special aspects of the subject which have been contributed by investigators working at the University of Chicago.

In order to safeguard the health of workers through an understanding of the toxicological manifestations of uranium, it was necessary to investigate experimentally (without the advantage of actual clinical experience with uranium poisoning) in order that information might be gathered that would suggest the probable symptoms, signs, and pathology that would occur if human beings were poisoned by uranium. In particular, practical organized knowledge was sought on toxicity, absorption, distribution and accumulation in various organs, excretion, pathologic effects (acute and chronic), mode of action, and if possible, diagnostic signs.

In experimental work, uranium compounds may be introduced into the organism by the following means: inhalation, contact with skin and mucous membranes, ingestion, and injection. The present work has been concerned only with the latter two avenues of entrance, i.e., ingestion and injection. The information and principles obtained in these ingestion and injection studies are of general significance, since (1) the uranium that is absorbed probably has comparable distribution and effect, regardless of the mode

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of entrance (excluding the specific effect of the uranium compound on the organ or tissue through which it enters the body), and (2) a high percentage of dusts, fumes, and vapors which are inhaled collects on the surfaces of the mouth, naso-pharynx, trachea, and larger bronchi and eventually finds its way into the gastro-intestinal tract.

This brief review consists of a general discussion of the nature of uranium poisoning followed by specific chapters concerned with its distribution and excretion, and gross and microscopic pathology. Special biochemical alterations, and the mechanisms of action of uranium and its transport to the tissues are also discussed.

*AECD - 1993-B Chapter II. Nature of Uranium Poisoning as Observed in Mice, by A. Tannenbaum and H. Silverstone, 7 p., November 1946, decl. 4/9/48.

Uranium is a highly toxic agent as has been frequently demonstrated by the intravenous, subcutaneous, or intraperitoneal injection of soluble uranium salts. The toxicity is dependent upon and modified by many factors, but probably the most important is the amount and rate of uranium absorbed into the blood and subsequently distributed to the tissues of the body. Exposure to some uranium compounds may be very great, and yet absorption and consequent toxicity be exceedingly low; also, absorption at a low level may occur over a considerable period of time, with gradual accumulation of uranium in the tissues, yet the toxicity may be slight.

Subsutaneous injections of uranyl nitrate are rapidly absorbed, and afford an excellent means of studying the clinical picture of acute uranium poisoning. Within 24 hours after injection with 4 or 8 mg of uranium as the salt, the animals are quite inactive and their furs ruffled; they tend to huddle together and feel flabby and cold. In spite of their inactivity, they are "irritable," moving erratically on stimulation. Later, their backs are arched and the mice appear smaller; their eyes are lusterless and inflamed. They show little interest in food or water. Gradually the animals become comatose and die.

With smaller lethal doses the picture is essentially similar except for the absence of "irritability"; the other signs all develop more slowly, but in the same sequence.

The mice injected with non-lethal dosages showed these toxic symptoms only transiently and to a much smaller degree; in fact, some mice evidenced no more than a temporary indifference to food and a slight loss in body weight or retardation of growth.

Usually, recovery is well under way by one month after injection of non-lethal dosages; the animals regain their weight and outwardly appear normal. However, this does not exclude the possibility that functional changes may still exist.

The main anatomic changes were seen in the kidneys. With both lethal and toxic dosages the kidneys were enlarged, and pink-grey (rather than the normal red-brown color) during the acute stage; Microscopically, a consistent sequence of changes occurred in the convoluted tubules. The earliest observed changes are cloudy swelling of the lining cells and usually a granular precipitate in the lumina; this progresses to necrosis of the epithelial cells (acute necrotizing nephrosis), desquamation, and finally regeneration. The glomeruli do not appear to be involved.

If the animal does not die during the acute period, recovery occurs. The kidneys return to normal size and are smooth and red-brown in color, except for the occasional appearance of pin-point yellow areas on the surface.

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When mice are fed moderately toxic dosages of uranium compounds (e.g. 1% uranyl nitrate in the daily ration of dba or ABC strain mice) the clinical picture is similar to that described above although the changes may occur more gradually.

As after injection, the mice which survive the acute episode recover. The striking feature of the recovery is that it occurs despite the continued daily ingestion of the same dosage of uranyl nitrate that caused the original acute poisoning, and that uranium continues to accumulate in the bones and kidneys--reaching levels far in excess of that which is found in these tissues during the acute reaction. These observations suggest that the acute poisoning does not depend mainly on the amount of uranium present in the tissues, and support the view that animals may acquire tolerance to uranium.

When mice are fed massive dosages (e.g., 4% uranyl nitrate in the daily ration) they also exhibit an acute reaction during which, depending on the strain and age of the mice, some die.

*AECD - 1993-C Chapter III. Factors Affecting Uranium Poisoning, by A. Tannenbaum and H. Silverstone, 8 p., November 1946 decl. 4/9/48.

As with most biological phenomena the effects of a particular agent or procedure may vary in degree in different hosts due to individual susceptibility and also may be modified by various factors. These factors are numerous and, with regard to uranium toxicity, only a few of the most important are discussed· nature of uranium compound, route of entry, specie and other biological variations, and previous exposure to uranium.

On feeding, the uranium compounds were found to have the following comparative toxicities for the mouse:

UO_2, U_3O_8, UF_4 -- relatively non-toxic, even in high dosages.

UO_3, UCl_4 -- toxic in high dosages.

$UO_2(NO_3)_2$, UO_4 $Na_2U_2O_7$ -- toxic in moderate dosages.

UO_2F_2 -- toxic, even at relatively low dosages.

The solubility of the uranium compound and its rate of absorption from the gastro-intestinal tract are probably the most important factors in determining its relative toxicity.

With most of the uranium compounds that are toxic, this property stems from its uranium content. However, the significance of the anion should not be neglected since the investigations suggest that for UO_2F_2 (and probably for its parent compound, UF_6) the toxic effects are more a problem of fluoride rather than uranium poisoning.

The avenues of entrance are important in that they result in different degrees of absorption into the blood, and because of the probability of local effects at the site of entry.

Uranium compounds fed daily in dosages 5 to 10 times the amounts lethal on single injection, result in comparatively little intoxication because of the limited absorption through the gastro-intestinal tract.

From comparative weight changes and determinations of uranium content of the kidneys, it is believed that absorption through the skin of mice was roughly about four times that which occurs on ingesting comparable amounts of uranyl nitrate over a similar period.

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It is believed that the inhalation of UO_2 dust does not produce toxic effects. It is guessed that inhalation effects are of an order somewhere between those obtained on ingestion and that following subcutaneous injection.

There is no question that the specie of animal plays an important role in the degree of toxicity produced by a given amount of uranium compound. For example, on subcutaneous injection of uranyl nitrate a single dose that will generally cause death in a high proportion of the experimental adult animals is of the order of 1 to 2 mg for the mouse, 2 to 4 mg for the rabbit, and 50 to 100 mg for the dog. It is obvious that the dosage for various species, on the basis of a unit of body weight, varies considerably.

Dependence upon strain of mouse was noted in the toxicity of uranyl nitrate fed in the daily ration.

There does not appear to be any consistent dependence of mortality of mice on the age of the animal when the comparison is drawn on the basis of a uniform dose. Male mice appear to be more resistant than the females, but the difference is relatively small and not invariable.

Experiments with mice, given uranyl nitrate either by injection or feeding, did not result in significant acquired tolerance as tested by subsequent injections. On the other hand, there is conslusive evidence that mice previously fed uranyl nitrate do acquire tolerance or resistance to further feeding of the chemical.

*AECD - 1993-D Chapter IV. Distribution in Tissues and Excretion of Uranium, by A. Tannenbaum and H. Silverstone, 11 p., November 1946, decl. 4/9/48.

In toxicology, knowledge of the absorption, distribution, and excretion of the poisonous substance is of importance not only in the understanding of the nature of the intoxication but also in the more practical aspects such as diagnosis and prognosis.

Two fundamental procedures have been employed with practical success in (the quantitative analysis of) uranium in tissues and excreta. One of these methods, depending on the fluorescence of uranium compounds fused with sodium fluoride, is an exceedingly sensitive means of detecting uranium. The second approach depends on the ionizing activity of the alpha particles emitted during radioactive disintegration of uranium. In both procedures, the ash of the tissue of excreta interferes by quenching or self-absorption necessitating the use of empirical correction factors.

A third analytic technique is that of radio-autography. While quantitation is not as practical by this procedure, it does serve well in demonstrating localizations within tissues and in illustrating differences between tissues.

Uranium has been detected by the fluorometric procedure in the tissues of animals that had no known exposure to uranium. The reported levels are very low and have only academic significance in the problem of uranium toxicology. When mice, rats, rabbits, or dogs are injected with uranyl nitrate the greatest concentrations of uranium in the body are found in the bones and kidneys. Concentrations of uranium found in selected tissues of a mouse 1 month after injection and of a dog about 2 months after injection, are tabulated. In both species bone and kidney are the principal sites of concentration of uranium following injection of uranyl nitrate. Liver and spleen contain considerably lower concentrations of uranium than kidney, yet these are higher than other soft tissues. In the rat also, the kidney

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and bone contain higher concentrations than do liver and spleen; this difference is great enough to be seen in radio-autograph films. In all studies on mice and dogs the concentration of uranium per gram of fresh composite bone was considerably greater than the concentration in kidney when the injected dosage was non-toxic. However, injection of toxic dosages in mice resulted in kidney concentrations equal to or greater than bone concentrations.

The actual amounts of uranium in a tissue depend not only on the concentration, but also on tissue mass. As a consequence liver, skin, muscle, and gastro-intestinal tract may account for considerable proportions of the uranium in the body despite the fact that they contain low concentrations. That the distributions of uranium in kidney and in bone are not homogeneous has been shown both by direct analysis of dissected tissue and by radio-autographs. Radio-autographs of the kidneys of mice and rats demonstrated much higher concentrations in the cortex -- principally toward the cortico-medullary junction. Radio-autographs and analyses of bone indicate that the uranium concentrates mainly in cancellous (spongy) bone and in the endosteum. The concentrations in the compact bone or in epiphyseal cartilage are relatively low.

When uranium compounds are fed in the daily diet, uranium tends to gradually accumulate in the tissues. The rates of accumulation appear to be dependent on the solubility in the gastro-intestinal tract (and by inference, absorption) of the compound fed. The rate of accumulation is also dependent on the concentration or amount of the compound in the diet.

In studying the excretion of uranium it is necessary to distinguish between the uranium coming directly from the exposure site and the uranium demobilized from the tissues proper. Determination of the uranium presents in urine and feces during or immediately after exposure serves to indicate the degree of and danger from exposure. In several studies with mice and dogs, the excretion of uranium has been determined following the injection of uranyl nitrate. When relatively small, nontoxic dosages of uranyl nitrate were injected, subcutaneously or intramuscularly, as much as 50 to 90% of the injected uranium was excreted, almost entirely in the urine, within 24 hours. Within one week less than 15% of the injected uranium remained in the body. When larger and toxic dosages were injected, however, mice excreted less than 10% of the injected dosage during the first 24 hours and one month after injection as much as 40% was still found in the body. A daily excretion of uranium of between 0.5 and 1.0% of the uranium in the tissues implies: (1) The total uranium in the tissues is of the order of 100 to 200 times that excreted daily; moreover, one may assume that 75% or more of this is in bone and kidney. (2) Through demobilization and excretion the uranium of the tissues will be reduced by one-half in 70 to 140 days.

*AECD - 1993-E Chapter V. Gross and Microscopic Pathology of Uranium Poisoning, by A. Tannenbaum, 16 p., November 1946, decl. 4/9/48.

During the course of many of the investigations animals were sacrificed to study the anatomic and histologic changes. The morphologic changes produced by acute uranium poisoning have been studied by many investigators; in the present discussion an attempt is made to describe both acute and chronic changes in the mouse and to correlate them with the clinical course (weight, appearance, mortality). There is little question that uranium may produce somewhat different morphological changes in different species. In most species however, the tubular necrosis is the outstanding anatomic change of the acute episode.

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Twenty-four hours after mice were injected subcutaneously with moderately toxic or lethal dosages of uranyl nitrate (1 to 2 mg) all the organs appeared relatively normal grossly except the kidneys; they were enlarged, pink-grey, and of smooth surface. Microscopically the kidneys revealed cloudy swelling of the convoluted tubules. Similar degenerative changes were present in the liver and myocardium. The lungs, spleen, pancreas, and gastro-intestinal tract were essentially normal. It appears that a single injection of uranyl nitrate results principally in a necrotizing nephrosis. If the animal survives, the nephrosis is repaired in a few weeks; the kidneys subsequently are relatively normal, except for the presence of the focal areas of calcification that were formed within the tubules in which necrosis of the epithelial cells occurred.

When uranium compounds were fed in the daily diet, both the clinical course and accompanying morphologic changes depended on the size of the daily dosages and on whether the uranium compound was fed in a highly toxic dosage directly or after having been gradually increased from lower dosages. It was determined that 20 mg of uranium as uranyl nitrate, when fed daily to mice, produced on acute toxic response in some strains and not in others. The kidneys were principally involved. Grossly they were enlarged, grey-pink, and had a smooth surface. A few mice died, but those that did not succumb, recovered relatively completely in 3 to 4 weeks. In an experiment in which the daily dosage of uranyl nitrate was successively increased from 5 mg of uranium (4 weeks) to 20 mg (7 weeks) to 40 mg (24 weeks), no significant changes were observed in the kidneys of sacrificed mice until 10 days after the 40 mg dosage was instituted. Results obtained indicate that cortical fibrosis (following the atrophy of the convoluted tubules that had been affected) occurs when large dosages of uranyl nitrate are fed; it may take somewhat longer to produce these chronic effects when the dosages are increased more gradually. Daily ingestion of a ration containing 80 mg of uranium (as uranyl nitrate) resulted in a severe acute reaction in all species of mice studied.

Once uranium is absorbed into the body tissues it produces its principal morphologic effect in the kidneys: a degeneration of the tubular epithelium. If the amount absorbed is toxic there is a resultant acute cloudy swelling of the lining cells of the convoluted tubules; with larger dosages, actual necrosis of these cells occurs. The glomeruli (in most species) remain virtually intact; this does not rule out the possibility of functional changes. By about 3 weeks following the single subcutaneous injection of a non-lethal dose the kidneys return to a relatively normal state. Following the acute renal response to daily feeding of moderate dosages, the kidneys also return to normal even though ingestion of the uranyl nitrate continues.

Fifteen photographs of kidney sections are included.

*AECD - 1993-F Chapter VI. Biochemical Effects of Uranium Poisoning, by S. Schwartz, 11 p., November 1946, decl. 4/9/48.

The biochemical manifestations of uranium poisoning revolve largely around signs of renal impairment, and especially of tubular damage. Essentially nothing has been reported on either acute or chronic uranium poisoning in man. Pertinent biochemical studies are therefore limited almost entirely to experimental dogs and rabbits administered uranium parenterally. The present survey is limited to a brief summary of reported studies and to a consideration of investigations made in the laboratory at the University of Chicago.

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Two periods may be considered in analyzing the biochemical effects of a single toxic or lethal dose of uranium. The early period is detectable within a few hours after administration of uranium and generally lasts 1-4 days. It is characterized by albuminuria, and commonly by increased per diem excretion of water and a number of other metabolites such as glucose, chloride, and phosphorus. Signs of nitrogen retention appear by the second day. Concentrations of blood non-protein nitrogen, urea nitrogen, and creatinine increase progressively. Impairment of liver function, as reflected by diminished excretion of phenyltetrachlorphthalein has been reported within three days after administration of 2 mg of uranium nitrate per kg body weight to dogs. The later period is characterized especially by increasing oliguria, and eventually by anuria on about the fifth to seventh day if the outcome is fatal. Excretion of nearly all metabolites decreases. It the animal survives 12 days it will usually recover. By this time glycosuria is nearly always absent, and albuminuria is sporadic. Urine specific gravity may remain low for several weeks.

In animals injected repeatedly with uranium, it is claimed that liver damage becomes of paramount importance, and death may be due to disease of this organ rather than to that of the kidney. Death in such animals may be associated with severe hypoglycemia. Mercury, cantharidin, potassium dichromate, and other nephrotoxins, also produce blood and urinary alterations similar to those of uranium poisoning.

Chief emphasis in investigations by the authors was placed on the exploration of new procedures which might be of value in the early diagnosis of overexposure to uranium in humans. For this reason, considerable study was made of personnel at the Iowa State College Project, Ames, Iowa. Investigations by E. S. G. Barron and co-workers at the University of Chicago confirmed the great sensitivity of the non-protein nitrogen determination as an early indication of uranium poisoning in animals.

Special consideration was give the study of uranium excretion in the urine of project personnel, since it alone might be expected to yield specific information on the degree of exposure to this metal. Good correlation was found between the urinary uranium concentration and the history of exposure to uranium

Studies by the authors confirmed earlier studies by the University of Rochester group on the elevation of urinary catalase following the administration of uranium to rabbits. In these animals, catalase excretion increased within the first 24 hours, reached a peak after several days, and returned to normal in 1-2 weeks.

In rabbits injected with 2-5 mg uranium nitrate per kg body weight there is a prompt reduction in the urinary excretion of coproporphyrin. Rabbits given 0.5 to about 2 mg uranium per kg body weight show a gradual increase in urinary coproporphyrin excretion, generally to 2-3 times above contron values. Several members of the Metallurgical Laboratory who worked with UO_2F_2 consistently excreted increased amounts of urinary coproporphyrin.

A marked fall in the excretion of urinary inorganic sulfur was found in rabbits injected with 1.5 to 4 mg uranium nitrate per kg body weight.

Essentially no significant abnormalities were found in the routine urinalyses of project personnel exposed to uranium. In rabbits injected with 3-5 mg uranium nitrate per kg body weight, the authors were especially impressed by the marked fall in urine specific gravity.

*AECD - 1993-G Chapter VII. On the Mechanism of Action of Uranium and the Transport of Uranium to the Tissues, by E. S. G. Barron, 9 p., November 1946, decl. 4/9/48.

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Uranium combines reversibly with serum albumin and forms strongly associated complexes with bicarbonate and with a number of organic acids. Uranium is transported to the tissues mostly as albumin-U and uranyl bicarbonate. Excreted into the kidneys by glomerular ultrafiltration of uranyl bicarbonate it diffuses into the tissues through the capillary walls. Uranium inhibits reversibly a number of enzyme systems. Complete reactivation was achieved with citrate and α-hydroxyaspartate. These compounds might be of use in the treatment of U poisoning. Some metabolic reactions in isolated cells were inhibited by amounts of U too small to produce enzyme inhibition; inhibition in these cells seems to be due to distribution of the metal on the surface of the cell. A number of metabolic reactions were inhibited in the kidney and the liver of U-treated rats.

*AECD - 1993-H Chapter VIII. Summary of Experimental Studies. Relationship to Uranium Poisoning in Man, by A. Tannenbaum and H. Silverstone, 9 p., November 1946, decl. 4/9/48.

In the concluding chapter of this brief survey of uranium pharmacology and toxicology, the pertinent facts obtained from experimental studies at the Metallurgical Laboratory are correlated and summarized. Utilizing knowledge obtained through animal experimentation, an attempt is made to interpret the significance of the data with respect to the problem of uranium poisoning in man. Such interpretations and conclusions must be considered as only suggestive and tentative.

From the data now available uranium appears to be less of a toxicological hazard than mercury or lead. The practice of good industrial hygiene, coupled with the not too toxic characteristics of uranium, should result in a decided lessening of the fear of uranium poisoning held by many when the present investigations began.

AECD - 1994 Production of New Tc Activities from Separated Mo Isotopes, by E. E. Motta and G. E. Boyd, 11 p., April 26, 1948, decl. 5/19/48.

For publication as a Letter to the Editor of Physical Review.

This paper reports only a part of the results from a general program for the characterization and assignment of the various radioactivities of element 43 produced by deuteron bombardments with the enriched Mo isotopes. The complete data and discussion will appear in a forthcoming article.

Data were obtained on the following Tc activities: 80 second Tc, 4.5 minute Tc, 40 minute Tc, and 2.8 hour Tc.

*AECD - 1995 The Separation of Milligram Amounts of Element 43 (Technetium) from Fission, by G. W. Parker, J. W. Ruch, and J. Reed, 1 p., n.d., decl. 5/18/48.

For publication in the program of the American Chemical Society in connection with the June Symposium on Property and Thermodynamics of Inorganic Substances.

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This document is an abstract and the entire text is reproduced here.

Although the short period isotopes of element 43 formed in fission were readily identified, the work of Sullivan, Lincoln, Schuman, and others on the suspected ground-state long-lived isotope, remained to become one of the last and most interesting discoveries in research dealing with the fission radioisotopes.

Soon after the announcement of the isolation of trace amounts of the long-lived isotope and establishment of the magnitude of half-life, a chemical, remote-control process was devised for the direct separation of the new element from fission, and several milligrams were isolated in a high degree of purity. In addition, this process yields as by-products, other interesting radioactive fission elements for which no production method has been established.

A number of physical and chemical properties of technetium have been observed, including color phenomena; spark, X-ray, and absorption spectra; estimation of half-life; mass assignment; and co-precipitation characteristics, and solubilities.

Photographs or drawings are presented where applicable to illustrate the process flow plan, crystalline form of the compounds, and the physical properties.

*AECD - 1996 The Separation of Milligram Amounts of Element 61 from Fission, by G. W. Parker and P. M. Lantz, 1 p., n.d., decl. 5/18/48.

For publication in the program of the American Chemical Society in connection with the June Symposium on Property and Thermodyanamics of Inorganic Substances.

This paper is an abstract and is presented here in full.

Notwithstanding the numerous advantages of the application of the method of ammonium citrate-differential elution from organic cation-exchange resin columns to rare earth separations, when applied directly to the fractionation of the gross uranium fission-product mixtures, a great variety of cross contamination is encountered. During the initial fractionation process, as an illustration, a particular rare earth may coincide almost exactly with elements of three or more groups; an alkali metal, a Group II trivalent element, a Group III trivalent non-fission contaminant, and a transuranic element. In addition, in a large scale remote-control operation, one cannot rely upon an efficient first-fraction collection of a rare earth without inclusion of most of the four nearest earths.

It is stated that methods have been developed which tediously eliminate each of the coinciding contaminants from the rare earth elements while work was directed principally toward the purification of milligram amounts of the ca 4y element 61^{147}. Methods of detection and illustration of extremely low limits of impurities of adjacent rare earths in the 61 are indicated by such characterizations as: spark and arc emission spectra, absorption spectra, mass analysis, and X-ray spectra. Neutron radio-activation in the Clinton pile is illustrated as a method of analysis which led to the identification of the 5.3d 61^{148} Color observations on element 61 indicate a pink form like neodymium as the nitrate and a canary yellow form like samarium as the chloride.

Incidental purification of the little known long-lived fission isotopes of Sm^{151} and Eu^{155} has permitted a more recent observation of their radiation characteristics.

AECD - 1997 Barnaby, by R. J. Smith, 8 p., August 4, 1945, decl. 5/24/48. (N-2077).

Disposition as required for use in research, development, or manufacturing work. This also includes declassification of the Barnaby.

A Barnaby is a transportable counting-rate meter for gamma measurements up to two hundred feet distant by means of a small probe on the end of an extension wire; used to probe wells and similar inaccessible points. Operating instructions, service notes, and three circuit diagrams are given.

AECD - 1998 Separation of Radium from Barium by the Use of an Ion-Exchange Column Procedure, by E. R. Tompkins, 6 p., October 31, 1947, decl. 5/20/48. (MonC-417).

For publication in such a journal as Science.

Application of an ion exchange procedure for separating radium and barium is described. The apparatus consisted of a column of Dowex 50 resin (colloidal agglomerates), 1 cm^2 by 15 cm, whose outlet tube was attached to a device for continuously monitoring and recording the concentration of β and γ emitting substances in the effluent from the column. A mixture of alkaline earth ions (with radioactive tracers for Sr and Ba) were first adsorbed at the top of the column by allowing a dilute solution of their salts to flow through the column bed. They were then eluted by passing a solution of 0.5 M ammonium citrate (pH 8)through the column at a rate of $\sim$ 0.3 ml/min.

By observing the continuous record of the β and γ activity in the effluent, fractions were collected in such a manner that the degree of separation of the solute ions could be determined. They were analyzed by determining the aluminum absorption and decay curves of the β and γ activity of aliquots of the various fractions and by following the decay (or growth) of α activity in those fractions containing α emitters. This data showed that nearly complete separation between strontium and barium and between barium and radium was obtained by this column separation method.

AECD - 1999 Progress Report for December 1944 (Section III, Part E-6), University of Rochester, 18 p., n.d., decl. 5/26/48.

Disposition as required for use in research, development, or manufacturing work.

Oxidation-reduction studies including polarography. The behavior of the U_6-U_4 system at the platinum electrode has been carefully studied. In connection with this work the effect of concentration on the absorption spectrum of the U_6-U_4 system has been investigated, and the effect of concentration of yl on the polarographic half-wave potential of the first cathodic wave has been studied.

Some work on the catalytic action of yl on the lactate-methylene blue system is reported, in which it demonstrated that yl slowly catalyzes the reduction of methylene blue by lactic acid. In addition the action of citrate in slowing both reduction of U_6 by leuco-methylene blue and oxidation of U_4 by methylene blue has been demonstrated, and an explanation given. An experiment has been performed on the reduction of yl in the presence of plasma by $Na_2S_2O_4$.

U complex formation. The inhibition by buffer ions at various pH values of the formation of certain colored complexes by yl has been studied (particularly ferrocyanide). The pH dependence of this inhibition has been explained in terms of the equilibrium between U cation and U anion complexes. The investigation of the effect of pH and buffer ions on the electrical transport of yl has been continued. An extension of the cation-anion-complex theory has been made which may prove useful in explaining reactions of U compounds with biological materials.

AECD - 2000 Progress Report for February 1945. (Section III, Part E-3), University of Rochester, 6 p., n.d., decl 5/26/48.

Disposition as required for use in research, development, or manufacturing work.

Oxidation-reduction studies, including polarography. Investigations have largely clarified the platinum electrode and polarographic behavior of U. These results are based upon rigorous mathematical relationship. It was concluded that at a U conc. = .0001 M, yl, U_5, and U_4 are combined with 3, 1, and 2 acetate molecules, respectively, above 0.05 molar acetate; and 2, 0, and 2 acetate molecules, respectively, below 0.05 molar acetate.

U-complex formation including electrical transport and spectro-photometric work. The effect of bicarbonate on the electrical transport of yl in the presence of protein has been investigated.

AECD - 2001 Isotope Shifts in Uranium Spectra. by L. E. Burkhart, G. Stukenbroeker, and S. Adams, 10 p., November 11, 1947, decl. 5/27/48. (Y-54).

For Publication in Physical Review.

A study is made of the isotopic shift of U^{238}, U^{235}, and U^{233} in the emission spectrum of uranium. The shift is sufficient to allow quantitative determination of the components of a mixture of the uranium isotopes by routine spectrographic analysis. Data show comparative values obtained by mass spectrometer and spectrograph.

*AECD - 2002 Magnetic Susceptibilities of Plutonium in Its Various Oxidation States in Aqueous Solution, by M. Calvin, M. Kasha, and G. E. Sheline, 4 p., December 20, 1946, decl. 5/14/48.

To be used in lectures and seminars and to be included in the NNES(MPTS).

The magnetic susceptibilities of the ions of plutonium in the +3, +4, and +6 oxidation states have been measured in aqueous solution. The correlation of the experimentally determined values with the electronic structure of the ions is briefly discussed.

AECD - 2003 Tetramethyl Lead Filled Geiger Counters, by H. A. Glassford and R. L. Macklin, 17 p., July 1944, decl. 5/24/48.

Disposition as required for use in research, development, or manufacturing work. This also includes the declassification of the tetramethyl lead filled Geiger counter.

A method consisting of filling counters with tetramethyl lead vapor to pressures from 1 to 2 cm Hg is studied. The technique is simple and yields a very high percentage of good counters which are

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stable over long periods, are not sensitive to moderate temperature changes and have wide, flat plateaus. They are fast, self-quenching counters and require only a simple single stage amplifier, the output of which can be fed directly into a scaling circuit. This report describes several types of counters, and suitable amplifier and the filling technique, in detail.

A simple, rugged system for filling counters with tetramethyl lead is shown diagrammatically and the essential parts of the system are shown in a photograph.

*AECD - 2004 Special Container (Three Drawings), Los Alamos, 3 p., February 5, 1948, decl. 5/26/48. (LADC-511).

Disposition as required for use in research, development, or manufacturing work.

This document consists of a series of engineering drawings which can be used in manufacture of a special high vacuum chamber in which materials can be handled.

AECD - 2005 Polarographic Analysis of U, by G. H. Tishkoff, 5 p., October 20, 1944, decl. 5/27/48. (M-1565).

Disposition as required for use in research, development, or manufacturing work.

The polarograph has proven to be a practical and rapid method of analysis of U_4 salts and UO_2 for amount of U_6 present as impurity.

The industrial samples of "green" salt submitted for analysis have been found by polarographic analysis to contain from 1 to 3 per cent UO_2^{++} by weight. The deviation for an average value of duplicate analyses of an individual sample is less than plus or minus 3 per cent, and deviations less than plus or minus 2 per cent can be obtained if larger samples are used.

With the polarograph, a technician can easily analyze eight to ten samples a day if two runs are made on each sample. The method also provides a permanent record of the results.

AECD - 2006 The Production of Leukopenia by Chronic Irradiation of the Abdominal Viscera of the Cat, by W. S. Adams and J. S. Lawrence, 11 p., April 30, 1948, decl. 5/24/48. (UR-25).

To be included in the NNES(MPTS), and for publication in Radiology.

Eight normal cats were irradiated in the following manner: daily doses (except Sundays) of 100 r each were delivered to the abdomen, the remainder of the cat being protected by a lead shield. A total dose of 3200 r was given. There was a uniform drop in the leukocyte count, polymorphonuclear leukocytes and lymphocytes (a fall of 64, 57, and 76 per cent respectively). This depression may

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be explained on the basis of any one, or a combination of the following factors:

(1) radiation of a larger segment of the bone marrow than had been suspected, (ionization chamber tests for "scatter" radiation showed that only very small amounts were affecting the part of the cat beneath the lead shield).

(2) alterations occurring in the liver and spleen which increased the rate of utilization, destruction, or production of leukocytes.

(3) alterations occurring in the intestinal wall which resulted in leukopenia possibly because of (a) increased demands for leukocytes, (b) increased loss of leukocytes through the damaged epithelial surface and or (c) decreased production of white blood cells because of failure to absorb or elaborate certain substances necessary for normal hemopoiesis.

(4) damage to an area rich in lymphoid tissue thereby producing lymphopenia.

The authors believe that factors 3 and 4 are probably the most important in the production of the observed leukopenia.

*AECD - 2007 Apparatus for Injection of Animals with Dangerous Amounts of Hard Beta and Gamma Emitters, by D. S. Anthony and W. P. Norris, 11 p., June 1946, decl. 4/23/48. (CH-3853).

To be included in the NNES(MPTS). This also includes declassification of the syringe and lead shield mounting.

In connection with studies on the metabolism of $(Ce\text{-}Pr)^{144}$ in experimental animals, it became necessary to develop a shield for a 2 ml hypodermic syringe.

A shield of polished lucite with a wall thickness of 1 cm was constructed and the syringe was held in place by screwing th threaded cap down until it jammed on the flange of the syringe barrel. With a shield of this type, the radiation at the surface was cut from 1 or 2 r/hour to about 10-20 mr/hour when the syringe contained 2 cc of a solution having a total of about 2 mc of $(Ce\text{-}Pr)^{144}$

In order to initiate experiments in rats concerning the toxicity and metabolism of Zr^{95} (maximum γ energy = 0 92 Mev) and its radioactive daughter Cb^{95} (γ energy = 0.75 Mev), it was necessary to devise a method of injecting a total of 50 mc of this material (Zr^{95} = 56 per cent, Cb^{95} = 44 per cent) without exposing the experimenters to more than tolerance doses of irradiation.

Conditions were fulfilled by an apparatus made from the stand of a small bench type drill press in which the drill was replaced by a 2 ml tuberculin syringe mounted in a 10 cm square lead block cut so as to expose the syringe on one side. The plunger of the syringe was elongated by attaching, by means of rubber tubing, a 10-inch lucite rod. The fixed-position syringe was filled by using a stock solution bottle. The stock bottle was handled by means of long tongs and held so that the syringe needle coincided with the center of the rubber dam. In order to shield the operator while filling the syringe, a wall of 10 cm thick lead bricks was placed between the operator and the apparatus.

Diagrams of the different devices described in the report are given.

*AECD - 2008 Uranium Dioxide Studies, by N. J. Ashenburg, 54 p., Jan. 30, 1948, decl. 5/17/48. (UR-2).

To be included in the NNES(MPTS).

See also AECD - 1780.

The chronic toxicity from exposure of animals to uranium dioxide has been determined at 2 atmospheric concentrations, 1 and 10 mg U/m^3. At the 1 mg level, 20 dogs and 174 rats were exposed, at the 10 mg level similar numbers of dogs and rats were exposed and in addition 25 rabbits and 30 guinea pigs. Exposure occurred for 6 hours daily except on weekends for a total of approximately 1600 exposure hours during the year, following a 30-day animal conditioning period for the collection of control data on the criteria under study.

Examination of the animals at the termination of the one year exposure showed that the level of 1 mg/m^3 of UO_2 dust did not effect changes in any of the criteria studied and was thus considered a "safe" level of exposure for animals The 10 mg level produced extremely mild renal pathological changes in 40% of the dogs and 10% of the rabbits the only two species showing these effects. Likewise, no biochemical changes were observed throughout exposure, but some increases in urinary protein of certain dogs and rabbits were seen Thus the purpose of these studies was fulfilled, namely, the determination of "safe" and "borderline" levels of exposure for a period of one year to uranium dust.

As is to be expected from the insolubility of uranium dioxide, large amounts of uranium (average 1000 μg/g) were retained in the lungs at the end of one year at the 10 mg level, but little accumulation of uranium occurred in the bone and kidney. Accumulation of even greater amounts of uranium was detected in the pulmonary lymph nodes in dogs and rats. No hematological changes of importance were noted.

*AECD - 2009 Quarterly Report, August 1947 to November 1947, edited by A. M. Brues, 177 p., November 1, 1947, decl. 5/12/48 (ANL-4108).

Disposition as required for use in research, development, or manufacturing work.

This document consists of a number of papers Eight of these papers, numbered AECD-2009 -A through AECD-2009-H, are individually abstracted below

*AECD - 2009-A The Early Distribution of $Sr^{89,90}$ in Rats, by W. P. Norris and W. E. Kisieleski, 10 p., n.d ecl 5/12/48.

Twenty white Sprague-Dawley rats (ca 200 g each) w e injected intravenously (tail vein) with 0.5 ml of isotonic sodium chloride, pH 6, containing 115 μc of a mixture of carrier free $Sr^{89,90}$ (ca 75 per cent Sr^{89}, 25 per cent Sr^{90}) in equilibrium with the Y^{90} daughter of Sr^{90}. Animals were sacrificed by decapitation at intervals of 1 min, 2 min, 5 min, 20 min, 1 hr, 6 hrs, 24 hrs, 3 days, 10 days, and 30 days after injection.

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The intravenous administration of Sr into the tail vein was attended by a retention of Sr in the tail which is not identical, in the first 1½ hours, to the metabolic picture observed in the other bones of the rat. The consistency of the results from several rats indicates that the initial high concentration of Sr in the tail is not the result of variable injection technique, but rather a result of a consistent loss into tissue or some other physico-chemical process occurring around the injection site at the time of administration.

During the period immediately after injection, there occurs a rapid uptake of Sr by the bones which continues for 1½ to 2 hours. This is shown graphically for the femur and scapula. The rate of uptake by the femur was almost exactly that for the scapula.

A second quantitative difference is demonstrated by the fact that, whereas the femur has acquired only 11 per cent of its maximum activity during the first minute after injection, the scapula, in the same period, has reached 25.5 per cent of its maximum value.

The time-content curves for all the bones femur, scapula, tail, and carcass (the Sr content of which is almost entirely in the bones after 3 days), indicate that the maximum bone Sr content, reached at about 90-120 minutes after injection, is maintained for about 6 days.

In a preliminary experiment to determine whether X irradiation can influence the gross picture of Sr metabolism, results obtained were identical, qualitatively and quantitatively, with that observed in the non-irradiated rats described.

*AECD - 2009-B Progress Report on C^{14}, by W. P. Norris and S. H. Cohn, 13 p., n.d., decl. 5/12/48.

A rapid method for routine counting of C^{14} is described. The C^{14} is counted as a carbonate layer under a thin mica end window Geiger-Mueller tube.

This method has the advantages of ease in preparation and mounting of samples and increased accuracy as a result of uniformity of counting conditions.

The accuracy and sensitivity are sufficiently high for most biological determinations.

*AECD - 2009-C Studies of Radiosensitivity of Cells, by L. O. Jacobson, et al., 13 p., n.d., decl. 5/12/48.

It has been commonly believed that the sensitivity of mammalian cells to ionizing radiations is proportional to cell activity in terms of mitotic proliferation—the more active the proliferation, the higher the sensitivity. An increased erythropoiesis can be initiated in the laboratory animal by phlebotomy or by the hemolytic action of acetyl phenylhydrazine on the circulating erythrocytes. The effect of 800 r whole-body X irradiation upon animals that have a previously induced regenerative anemia was compared with the effect of this same dose on normal animals of comparable age and weight. The normal irradiated animals developed an anemia that reached a maximum at 14 days. The animals in which a regenerative anemia had been produced prior to irradiation with 800 r developed no further anemia. The recovery time in both groups was comparable (23 days). The mean reticulocyte value of the phenylhydrazine-injected, X-rayed animals was reduced below the normal control value on the 6th post-irradiation day only. The phlebotomized group of animals responded to irradiation in a manner comparable to the animals treated with phenylhydrazine and X-ray.

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The histologic studies made on appropriately sacrificed animals revealed that erythropoietic tissue in the bone marrow and the spleen was essentially completely destroyed by 3 days in normal animals that received 800 r. A relatively slow recovery ensued beginning on the 7th to the 9th day. On the other hand, the erythropoietic tissue in the bone marrow and spleen was only partially destroyed in animals that were irradiated with 800 r after a regenerative anemia was produced by phenylhydrazine or phlebotomy.

These data would tend to indicate that erythroblast vulnerability to irradiation injury is not enhanced by increased mitotic activity and proliferation. In fact, the hyperplastic erythroid tissue sustained less histologic injury than the normal, and the production of erythrocytes was maintained.

*AECD - 2009-D The Effects of Folic Acid on the Anemia Induced by X Irradiation, by S. P. Stearner, 8 p., n.d., decl. 5/12/48.

In this experiment, the number of animals observed was not large and the results obtained showed only small differences. For these reasons, no definite claim can be made concerning the therapeutic effect of folic acid on the damage resulting from X irradiation. The results can only be considered to be suggestive of a positive effect. Jacobson, however, stated that in patients treated with irradiations or nitrogen mustards, folic acid has not been shown to produce any but equivocal results. Further work is necessary to establish more definitely the possible effectiveness of folic acid in alleviating the leucopenia and anemia that follow irradiation.

*AECD - 2009-E Progress Report on the Chronic P^{32} Mouse Experiment, by H. Lisco, M. Finkel, and G. Hirsch, 8 p., n.d., decl. 5/12/48.

The data that are being collected on the CF-1 female mice that either received a single intraperitoneal injection or are receiving monthly injections of radiophosphorus are beginning to reach proportions which permit tentative analysis. At 290 days after the initial injection in each series (single and repeat doses), 20 per cent of the total of 937 animals had died or had been sacrificed in a moribund condition. Although the final complete diagnosis of many animals must await histological study of one or more tissues, it is possible at this time to note some radiation effects.

The tentative conclusions at this interval in the experiment (290 days) are that. (1) The incidence of lymphoma is increased in the groups which received 10.0-5.0 μc/g and 1.0-0.5 (and probably 0.1) μc/g/mo of P^{32}. There is no evidence at 290 days that animals receiving low doses of radiophosphorus have a decreased probability of developing lymphoma. (2) The incidence of mammary tumors among CF-1 female mice which received 10.0-0.01 μc/g of P^{32} or which are receiving 1.0-0.01 μc/g/mo is not different from the spontaneous occurrence of mammary tumors in this strain. (3) The incidence of lung tumors is increased by 10.0-5.0 μc/g and 1.0-0.1 μc/g/mo of P^{32}. (4) Growth is retarded by 1.0-0.5 μc/g/mo of P^{32}.

*AECD - 2009-F Studies on the Distribution of Plutonium in the Rat, by W. Kisieleski and L. Woodruff, 20 p , n.d , decl. 5/12/48.

The citrate and nitrate salts of plutonium in the +6 valence states were injected intramuscularly into male rats at a dose of 0.1 μg/g.

Animals were sacrificed at intervals from 7 to 420 days, and the plutonium content of the various tissues was determined by the standard LaF_3 method for plutonium determination

When plutonium is injected intramuscularly as the citrate salt, the presence of the citrate as compared to nitrate seems to increase absorption of the plutonium from the site of injection. After 10 days 51 per cent of the injected dose was found in the injected leg of the nitrate animals where only 30 per cent was found in the citrate group. At the termination of the experiment (420 days) 20 per cent was found after injecting the nitrate as compared to 12 per cent with the citrate.

The skeleton was the principal site of deposition regardless of the form in which the plutonium was injected. Liver was next in order, containing 2 per cent of the injected dose at 10 days in the nitrate animals and 5 per cent in the citrate group.

The spleen contained only about 0.1 per cent of the injected dose in both the citrate and nitrate animals, though in specific activity (μg/g of wet weight) it was as high as liver or bone.

Most of the other soft tissues contained insignificant amounts of plutonium activity and it was noted that this concentration decreased with time, the gonads being the exception, where a reverse trend was observed.

There was no evidence to show translocation of plutonium from the soft tissues into bone.

All of the tissues in the citrate groups showed a higher initial uptake than can be seen in the nitrate groups.

The specific concentration of the various tissues gives a better picture of the increased initial uptake by the citrate group as compared to the nitrate. At 7 days the specific activity in μg/g of wet weight of liver in the nitrate group was 0.039 μg/g, while the citrate was 0.214 μg/g. The specific activity of the spleen was as high as liver having 0.043 μg/g at 7 days in the nitrate group and 0.123 μg/g in the citrate group. Bone in the citrate group at 7 days was 0.533 μg/g, while it was 0.398 μg/g in the nitrate group.

A significant difference was noted in the specific concentration in thymus in the 2 groups. The concentration was only 0.008 μg/g in the nitrate group at 7 days, while it was 0.046 μg/g in the citrate group.

*AECD - 2009-G Estimation of Thyroglobulin Iodine by Slow Neutron Irradiation, by A. M. Brues and O. H. Robertson, 7 p., n.d., decl. 5/12/48.

The absorption of slow neutrons by certain elements results in their conversion to radioisotopes which can readily be measured. In many cases, using pile neutrons, this provides a method of microanalysis much more sensitive than that afforded by chemical procedures. It appeared that the method might be useful in the micro-determination of iodine by the reaction $I^{127}(n, \gamma)I^{128}$ followed by estimation of the radioelement I^{128}. The reaction has a fairly high cross section (6.8×10^{-24} cm^2), and I^{128} has energetic beta and gamma emission and a 25-minute half-life. It would appear that the chief interfering substance might be Cl^{37}, with a 35-minute half-life. In the case of analysis of thyroglobulin in thyroid tissue, chloride, and other diffusible ions can be removed by dialysis. Carbon, hydrogen, oxygen, nitrogen, and sulfur do not produce seriously interfering isotopes; that of phosphorus (P^{32}) is unimportant due to its relatively long half-life.

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Two samples of thyroglobulin (4.8 and 9.9 mg) were exposed to slow neutrons for short periods. After removal from the pile, they were placed as uniformly as possible on the surface of a flat porcelain dish and read at intervals under an end-window Geiger-Mueller counter. The presence of activity with a 25-minute half-life is clearly shown. Since chemical analysis of the material failed to show chloride, the activity is thought, for practical purposes, to be entirely due to I^{128}.

*AECD - 2009-H The Mechanism of Uranyl Nitrate Inhibition of Cell Metabolism, by E. S. G. Barrón and B. Gasvoda, 30 p., n.d., decl. 5/12/48.

Crystalline plasma albumin combined with uranium at both sides of its isoelectric point. At the alkaline side the combination was dissociated on addition of citrate but not of phosphate. At the acid side it combined more strongly and it was not dissociated on addition of phosphate or citrate. Uranium inhibition of glucose metabolism by yeast was also dissociated at pH 7.3, while it was not at pH 3.8. The inhibition produced by uranium was instantaneous and was roughly proportional to the ratio, total nitrogen/uranium. Glucose oxidation by bacteria was little affected or not at all. Lactate oxidation by gonococci, succinate oxidation by E. coli, and the respiration of sea urchin sperm were reversibly inhibited by uranyl nitrate. Inhibitions were released on addition of phosphate and citrate. These experiments are presented as evidence that uranium inhibition of cellular metabolism is due to combination of the metal with the protein of the cell membrane, which renders the membrane impermeable to metabolites.

*AECD - 2010 The Effect of X-Rays on the Rat Incisor, by P. P. Dale, 1 p., n.d., decl. 5/19/48.

For publication in the Journal of Dental Research.

This paper is an abstract and is presented here in full.

Five groups of 30 weanling and 30 adult rats of equal sex distribution were exposed to single, whole-body exposures of 0, 375, 500, 625, and 750 roentgens (r) administered under constant conditions of 250 kv; 15 m.a.; Al parabolic filter and $\frac{1}{2}$ mm Cu; H.V.L. 2.1 mm Cu, and 44 minutes time. Thirty days after exposure, the survivors were sacrificed and the teeth of all animals were examined grossly. Eight animals per group were studied histologically by means of ground and decalcified sections.

Data disclosed a slightly greater mortality among males, with no apparent age difference: Controls - 0; 375r - 1 (adult female otitis media); 500r - 6(3 oo); 625 - 22 (16 oo) and 750r - 50(28 oo).

Gross examination (x 30) revealed increased peridental disturbances edematous and bleeding gingivae) and enamel hypoplasia as exposure increased. Histologically, there was temporary retardation or cessation of both enamel and dentine formation, with apparently normal recovery at the formative and of the incisor. At 275r the enamel was affected more than the dentine and was characterized by small, irregular, amorphic and discolored enamel rods with dark inclusion bodies in the interprismatic substance.

*AECD - 2011 The Acute Radiotoxicity of Injected Na^{24} for Mice and Rats. Part I. Metabolism and General Toxicity, by R. D. Finkle, et al., 27 p., June 1946, decl. 5/24/48. (CH-3856).

To be included in the NNES(MPTS).

Introductory work on the toxicity and metabolism of radioactive substances derived from uranium fission was started indirectly by using cyclotron bombarded sodium^{24}, an artificial radioactive isotope with a half-life of 14.8 hours. The isotope decays by emission of β-particles (1.4 Mev) and γ rays (1.4 to 3.6 Mev) to stable magnesium.

Mice and rats were administered doses of radioactive sodium (Na^{24}) ranging from 12 to 150 microcuries per gram of body weight. It is apparent that the LD_{50} lies between 20 and 40 μc/g with the possibility that females may be more sensitive than males.

Immediately after injection of 33 μc/g or more, there was a drop in weight with the rate and magnitude of the loss varying with the dose. At the lowest dose level, 12 μc/g, there was no significant effect on growth. Clinically, aside from loss of hair, encrusting of the eyelids. and hunched position of the animals at death, no characteristic lesions were noted.

Rats that received 90 mg by intraperitoneal injection excreted 19 per cent of the radioactive sodium in the first day and another 9 per cent on the second day. Rats given smaller doses excreted an average of 15 per cent on the first day and 12 per cent on the second. The ratio of the fecal sodium content to the urinary content was .05 or less.

In mice, the sodium turnover was somewhat faster than in rats. Mixed excreta measurements showed 33 per cent of the sodium excreted by 24 hours and 50 per cent by 72 hours.

Analytical recovery of the injected sodium was between 80 per cent and 100 per cent in most groups.

Discounting the systematic errors and the uncertainty for X-ray comparison, it might be said that the ratio of beta ray effectiveness to roentgen ray effectiveness is approximately one.

AECD - 2012 The Metabolic Properties of the Fission Products and Actinide Elements, by J. G. Hamilton, 49 p., March 1948, decl.5/26/48. (UCRL-67).

For publication in a technical journal.

An investigation of the assimilation, distribution, retention, and excretion of the fission products and actinide elements in the rat has been conducted at the Crocker Radiation Laboratory, University of California, Berkeley, California. These studies were initiated October 15, 1942, and are continuing at the present time. An extensive survey has been made of the metabolism of twenty-two different radioelements in the rat.

Radioactive materials were administered by mouth and by injection. The fission products studied included the carrier-free radioactive isotopes of strontium, yttrium, zirconium, columbium, ruthenium, tellurium, iodine, xenon, cesium, barium, lanthanum, cerium, praseodymium, and element 61. In addition, the eight members of the actinide series which were subjected to metabolic experiments included actinium, thorium, protactinium, uranium, neptunium, plutonium, americium, and curium. The results of these studies indicated that most of the fission products and all of the heaviest elements are absorbed to a very small degree by way of the digestive tract, deposited primarily in the skeleton following parenteral administration, and eliminated very slowly from that organ. The fission

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products studied which are accumulated in the skeleton include strontium, barium, yttrium, lanthanum, cerium, praseodymium, element 61, zirconium, and columbium. From 25% to 70% of the material absorbed following parenteral injection is laid down in the skeleton and is eliminated from that organ at rates less than the rates of radioactive decay, with the exception of Cb^{95}, Ce^{144}, 61^{147}, and possibly Sr^{90}. The remaining five long-lived radioelements, ruthenium, tellurium, xenon, iodine, and cesium, do not show any significant degree of localization in the skeleton and, in addition, there is no remarkable deposition in any of the other tissues with the exception of the accumulation of iodine in the thyroid gland. The rate of elimination for all of these five radioelements is much greater than their rate of radioactive decay with the exception of iodine deposited in the thyroid. In this particular case, the release of the accumulated iodine in the thyroid is much slower than its rate of radioactive decay. The members of the long-lived fission product group which are absorbed by way of the digestive tract include strontium, barium, tellurium, iodine, and cesium. The uptake by the skeleton of the eight members of the actinide group is very similar to that observed with the members of the fission product series studied which are deposited in this structure. With the exception of uranium, elimination from bone occurred very slowly.

Radioautographic studies indicated that strontium, and presumably barium, are deposited primarily in the mineral structure of the bone. The other fission products deposited in this organ are laid down in the region of the inner and outer coverings of the bone and about the trabeculae, but do not apparently enter in to the mineral structure of this organ to a degree comparable to strontium. In the case of the actinide elements, a similar accumulation in the region of the non-mineralized portion of the bone has been observed with actinium, thorium, plutonium, americium, and curium. The curious property of the members of the fission products and the majority of the actinide elements to be laid down in this portion of the skeleton and to be retained there for prolonged intervals, renders them of considerable concern from the point of view of the possible medical hazards to be encountered should these materials be accidentally introduced into the body.

AECD - 2013 The Effect of Folic Acid on the Response of the Peripheral Blood and Blood-Forming Tissue of the Rat to Parenterally Administered Strontium^{89}, by L. O. Jacobson, S. P. Stearner, and E. L. Simmons, 24 p., March 15, 1948, decl. 5/18/48. (ANL-4125).

For publication in Blood.

See MDDC-1418-B.

Female white rats from the sprague-Dawley farms were injected intraperitoneally with 4.2 μc/g Sr^{89} and were treated with daily injections of 15 μg folic acid. Hematological studies were made of the peripheral blood before injection and at 3, 6, and 8 weeks after the Sr^{89} injection. The experiment was then terminated and all surviving animals autopsied for histological study of the blood-forming tissues.

Folic acid had no observable effect on the macrocytic anemia and leucopenia that developed after the administration of Sr^{89}. When given daily from the start of the experiment, folic acid did not prevent the appearance of the effects of Sr^{89} on the peripheral blood; when it was given after the appearance of radiation effects, no improvement was observed. Although the reason is not clear, survival appeared to be poorer in the groups that received folic acid and Sr^{89} than in the group that received Sr^{89} alone.

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Histological study showed that Sr^{89} produced damage to bone marrow and lymphatic tissue. Very little evidence of regeneration was apparent at the time of autopsy. Bone marrow damage was largely compensated for by increased ectopic myelopoiesis in the spleen. Sr^{89} animals that received folic acid showed no more active regeneration in hemopoietic or lymphatic tissue than rats that had received only Sr^{89}. The macrocytic anemia observed in the peripheral blood of strontium-injected animals was not accompanied by a megaloblastosis in the blood-forming tissue.

*AECD - 2014 The Effect of Total Body X-Irradiation and P^{32} on the Peripheral Blood of Normal Rats and Rats with Cobalt-Induced Polycythemia, by L. O. Jacobson, et al., 2 p., March 1948, decl. 4/20/48. (ANL-HDY-472).

For oral presentation before a meeting of the American Society of Clinical and Laboratory Technicians, and for publication in a bulletin of that society.

This document is an abstract and is presented here in full.

A polycythemia was produced in Sprague-Dawley rats by the subcutaneous injection of cobaltous chloride 5 times weekly. The polycythemia was fully established in 90 days. The effect of X-irradiation or P^{32} on the blood and blood-forming tissue of normal animals and those with induced polycythemia was studied.

Six groups of seven rats each were treated in the following manner. Group I. Control - No treatment was given this group. Group II. Control-cobalt - The animals were injected with cobaltous chloride 5 times weekly. Group III. X-ray + cobalt - The animals were injected with cobaltous chloride 5 times weekly. When polycythemia was fully established, 300 r whole-body X-ray was administered in a single dose. The cobalt injections were continued after X-irradiation. Group IV. P^{32} + cobalt - The animals were injected with cobaltous chloride 5 times weekly. When polycythemia was fully established a dose of radiophosphorus (1 μc/g body weight) was administered intraperitoneally. The cobalt injections were continued following the administration of P^{32}. Group V. X-ray - Normal animals were given one single exposure of 300 r whole-body X-radiation. Group VI. P^{32} - Normal animals were given one single injection of radiophosphorus (1 μc/g body weight).

A comparable depression of the leucocytes of the peripheral blood was produced in normal and polycythemic animals after radiophosphorus injection. The dosage of radiophosphorus (1.0 μc/g), used in this experiment, produced no significant effect on hemoglobin, erythrocyte or hematocrit values in normal or polycythemic animals.

A comparable reduction in hemoglobin, erythrocyte, hematocrit and leucocyte values of the peripheral blood occurred in normal and polycythemic animals exposed to 300 r whole-body X-radiation. Recovery was essentially the same in the two groups. Histological studies of appropriately sacrificed animals in these various groups have not been completed.

On the basis of these data no apparent difference in the sensitivity of the hemopoietic system to a single dose of P^{32} (1.0 μc/g) or to X-irradiation (300 r) is evident between normal and polycythemic rats as judged by the pattern of response of certain hematologic constituents of the peripheral blood.

AECD - 2015 Biochemical Studies on Workers Exposed to Beryllium, by E. J. Katz and J. J. Nickson, 19 p., February 1, 1948, decl. 4/30/48. (ANL-4119).

For oral presentation at the Saranac Symposium, and for possible publication in a technical journal.

Clinical laboratory studies of workers exposed to varying amounts of beryllium were carried out for a period of one year in the hope of detecting and evaluating systemic subclinical metal poisoning.

Individual abnormalities were found with thymol turbidity cephalin cholesterol, urine coproporphyrin, urine pigments, and serum bilirubin determinations. None of the tests showed consistent elevation.

The interpretation of results must be largely on an individual rather than a statistical basis and must be combined with carefully kept case histories. This is especially important where exposures may be both multiple and minimal in amount.

AECD - 2016 Thrombopenic Purpura. The Failure of Direct Blood Transfusion to Raise the Platelet Level, by J. S. Lawrence, W. N. Valentine, and W. S. Adams, 12 p., April 15, 1948, decl. 5/25/48. (UR-22).

For publication in the Journal of Laboratory and Clinical Medicine.

Because previous experimental evidence had been obtained in this laboratory to the effect that the blood platelet level of cats rendered thrombopenic by roentgen radiation may be significantly raised by cross circulation with a normal animal, it was deemed pertinent to investigate the possibility of raising platelet levels of thrombopenic human subjects by massive direct blood transfusion. This was done in three instances, once in a patient markedly thrombopenic on the basis of aplastic anemia, and twice in a human subject with idiopathic thrombopenic purpura. In no case was less than 1500 cc whole blood transfused and in no case was this amount of blood transfused over greater than a 3 to 4 hour period. In the case of aplastic anemia the multiple syringe method was used while in the remaining two transfusions the Pennell direct transfusion apparatus was employed.

In no instance was it possible to elevate the recipient's blood platelet level for more than a very transient period of time. In the case of aplastic anemia no elevation whatsoever occurred. In the case of thrombopenic purpura an ephemeral elevation disappearing after three to four hours was the only salutary effect. It was concluded that with the methods of direct blood transfusion employed, no platelet elevation of practical significance resulted from massive transfusion. The direct transfusion apparatus available for use with human subjects is of course not comparable to the continuous endothelial anastomosis of the animal experiment.

AECD - 2017 Synthesis of Nucleic Acid in Surviving Normal and Cancer Tissue Slices Studied with Radio Phosphorus, by W. Mann and J. Gruschow, 6 p., April 12, 1948, decl. 5/12/48. (UR-20).

For publication in Archives of Biochemistry.

Radioactive phosphorus in the form of phosphate was used to study the synthesis of nucleic acids in both normal and tumor tissue slices, as measured by the incorporation of radioactive phosphorus into nucleic acid. The experiments demonstrated a dependence of nucleic acid synthesis on the presence of oxygen. The synthesis mechanism was inhibited by nitrogen. With tumor tissue, this nitrogen inhibition was significantly less when substrate was added, indicating that the energy required for nucleic acid synthesis can be furnished by glycolysis.

AECD - 2018 The Deposition of Uranium in Bone. 5. Ion Exchange Studies, by W. F. Neuman, M. W. Neuman, E. R. Main, and B. J. Mulryan, 11 p., n.d., decl. 4/28/48. (M-2018).

To be included in the NNES(MPTS), and for publication in the Journal of Biological Chemistry.

Previous studies have indicated that the fixation of uranium by bone is, for the most part, a surface phenomenon involving ionic exchange.

This is a report of a series of investigations of the ionic exchange mechanism. First a comparison was made of the ability of several bone preparations to adsorb uranium in vitro with their ability to exchange phosphate and calcium ions. Second, a study was made of the effect on phosphate and calcium exchangeability of a preliminary saturation of glycol ashed bone with uranium.

A correlation was demonstrated between the magnitude of the fraction of exchangeable calcium and phosphate of bone preparations and their ability to fix uranium. The presence of adsorbed uranium inhibited the exchange of bone calcium and phosphate.

These results confirm the view that uranium fixation by bone involves an ionic exchange.

AECD - 2019 The Deposition of Uranium in Bone. 6. Ion Competition Studies, by W. F. Neuman, M. W. Neuman, E. R. Main and B. J. Mulryan, 13 p., n.d., decl. 5/5/48. (M-2019).

To be included in the NNES(MPTS) and for publication in the Journal of Biological Chemistry.

Previous studies have indicated that the deposition of uranium in bone is a surface-limited reaction involving an exchange of the uranyl ions of the solution for some ion in the surface of the mineral phase of bone, probably calcium. As a further test of the exchange hypothesis, a series of ion-competition experiments was conducted, in which the effects of varying concentrations of hydrogen, bicarbonate, phosphate, and calcium ions were observed. Evidence was obtained which confirmed the exchange hypothesis and established calcium as the surface ion in bone which uranium displaces. All available data have been summarized, and the mechanism of the opposition of uranium in bone is discussed in detail.

*AECD - 2020 Studies of Liver Function in Experimental Animals with Special Reference to Radiation and Metal Exposure, by S. Schwartz, et al., 38 p., July 31. 1947, decl. 5/12/48. (CH-3855).

To be included in the NNES(MPTS).

The studies of liver function described in this report are part of a larger series of studies.

A battery of functional tests was investigated. These were chosen to include expecially tests of liver, kidney, adrenal, and bone marrow activity. The tests chosen were not necessarily meant to be specific in identifying the noxious agent responsible for any given abnormal result, but rather to cover a

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fairly wide range of functions. Abnormalities would then have their main value as warning signs, or as screening reactions to indicate which subjects required further careful study. In addition, the development of biochemical abnormalities in controlled animal experiments might be expected to give added insight into the nature of the toxic process.

Though tests of liver function are especially nonspecific as regards the etiology of abnormal results, they were given considerable emphasis in the program because of the well-known role of the liver in many detoxification processes.

Total-body X radiation was administered, under supervision of members of the biology section, with a 200 kv X-ray machine operated at 15 ma. Radiation was delivered at the rate of about 6 r per minute. One-half mm copper and one mm aluminum filters were used.

Plutonium and strontium^{89} were administered intravenously or intramuscularly.

The various (nonradioactive) metals studied were injected subcutaneously in the thigh. These metals included beryllium, lead, uranium, thorium, mercury, arsenic, and lanthanum. Relatively extensive studies of liver function were made only with beryllium. In addition, the effect of BAL was studied in relation to the use of this substance in the treatment of metal poisoning. The metal salts used were dissolved in water and generally brought to pH 5-6 by the addition of sodium hydroxide.

Chief emphasis was given to the excretion of urinary urobilinogen. This test, employing Watson's method, was chosen.

Three tests for liver function were investigated in the hope that they might be made applicable to the experimental animals. These tests were: (1) the cephalin flocculation test of Hanger; (2) the colloidal gold test of Gray; and (3) the thymol turbidity test of MacLagen. Most complete studies were made of the first of these tests in dogs, rabbits, and rats, as well as in human subjects. Occasional analyses of serum bilirubin were also made. Venous blood was used in the dog studies. Cardiac blood was drawn from rabbits and rats.

In the present work only urine studies were done routinely in the rabbits; both urinary and fecal excretion of porphyrin was followed in many of the irradiated dogs.

It is apparent from the data presented that liver function, as reflected in urinary excretion of urobilinogen, was not profoundly affected, except terminally, in animals exposed to lethal amounts of radiation. Furthermore, any changes in serum proteins produced by radiation were not associated with significant changes in the serum tests of liver function used.

These results are in agreement with the general consensus of opinion in the literature.

*AECD - 2021 Inhibition of Enzymes by Uranium, by T. P. Singer, et al., 56 p., n.d., decl. 5/11/48. (CH-3739).

To be included in the NNES(MPTS).

See also MDDC - 759.

The effect of uranyl nitrate on the activity of 28 enzyme systems, many of them in pure crystalline state, has been studied. Some of the enzymes (succinoxidase, hexosemonophosphate oxidase, lysozyme) were completely inhibited; others (pyruvate dismutation, pancreatic esterase, cytochrome oxidase, monoamine oxidase, carboxypeptidase, cathepsine, urease) were partially inhibited; and still others (hexokinase, choline oxidase, pyruvate oxidase) were slightly inhibited. Fifteen other enzymes were not affected. The combination of uranium with the protein moiety of enzymes is reversible. Enzyme

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reactivation of different degrees occurred on addition of citrate, α hydroxyaspartate, oxaloacetate, malate, tartrate, malonate, and oxalate. Reactivation is the consequence of successful competition for uranium that is thereby removed from its combination with protein. The most powerful competitors for uranium seem to be substances that form cyclic complex compounds where union between the metal and the organic acid is through both ionic and covalent bonds.

AECD - 2022 The Effects of X-Irradiation on the Peripheral Blood and Blood-Forming Tissues of Splenectomized Rats, by S. P. Stearner, E. L. Simmons, and L. O. Jacobson, 40 p., October 1, 1947, decl. 4/23/48. (ANL-4100).

For publication in the American Journal of Pathology.

See also MDDC-1319.

White rats were splenectomized and after 5 days, exposed to 600 r and 100 r X-radiation. Although a leucocytosis was frequently seen after splenectomy, in some cases no significant change in the peripheral leucocyte count was observed. The lymphopenia and granulopenia that followed exposure to radiation were as severe in splenectomized rats as in intact rats.

Histological studies indicated that splenectomy did not produce a significant hyperplasia of lymphopoietic or granulopoietic tissue in the rat. Therefore, there was no opportunity to compare the effects of radiations on normal and hyperplastic leucocyte-forming tissues.

The functions of the spleen are not clearly understood, but appear to be complex. It is possible that splenectomy may produce numerous physiological changes which complicate the interpretation of radium effects on the blood-forming organs. Although the reason is not clear, the results make it apparent that splenectomy is not a satisfactory technique for producing a hyperplasia of lymphopoietic or granulopoietic tissue.

In Bartonella-infected rats, splenectomy resulted in a severe anemia. In animals that survived, irradiation with 600 r did not cause a more severe anemia, but markedly retarded the recovery. The bone marrow of these animals was shown to contain a hyperplasia of erythroblastic elements. A small percentage of erythroblasts persisted during the early stages following irradiation of splenectomized rats, although none were seen at this time in intact irradiated animals. Later, however, damage appeared to be equally severe in both irradiated groups.

AECD - 2023 The Effect of Roentgen Radiation on the Production of Thoracic Duct Lymphocytes, by W. N. Valentine, C. G. Craddock, and J. S. Lawrence, 9 p., n.d., decl. 4/23/48. (UR-16).

For publication in the American Journal of Medical Science or Radiology.

A study was made of the effect of 1500 r whole body irradiation on the numbers of thoracic duct lymphocytes and rate of flow of thoracic duct lymph in cats. Since the procedure of thoracic duct cannulation itself results in some reduction in lymphocyte numbers and lymph flow, it was necessary to compare irradiated animals with an untreated control group. Nine control animals were

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employed while eleven animals were used in the irradiated group. In each animal lymph was collected in hourly or two-hourly volumes and studies were made to ascertain the volume, total lymphocytes, and lymphocytes per cu mm of each specimen. In each case the values for the first two hours flow were expressed as 100 per cent and the values of each subsequent specimen computed as a percentage of this baseline. Animals were irradiated after a normal baseline was obtained.

The total number of lymphocytes in thoracic duct lymph falls rapidly after heavy whole body irradiation as does the lymphocyte count per cu mm of lymph. There is only slight difference in rate of lymph flow in control and irradiated groups. Data are presented on these points. The data suggest that from the time irradiation was begun the total production potential of the lymphoid tissues drained by the thoracic duct did not exceed about 4 hours normal supply. In terms of the peripheral blood, this amounts to ability to replace via thoracic duct lymph about 50-60 per cent of the circulating lymphocytes before total exhaustion ensues.

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